elmhurst energy

SAP Report Submission for Building Regulations Compliance

Client: Shorewood Homes Ltd

Project: Tree House, Larg Drive
Winchester, Hampshire, SO22 6NU

Contact: Scott Spearing
Scott Spearing
scott@beatsolutions.co.uk

Report Issue Date: 01/03/2023

EXCELLENCE IN ENERGY ASSESSMENT

BASIC COMPLIANCE REPORT
Calculation Type: New Build (As Designed)

Design SAP
elmhurst energy

Property Reference	SAP-1425 - Plot 2	**Issued on Date**	01/03/2023
Assessment Reference	REV-	**Prop Type Ref**	
Property	Tree House, Larg Drive, Winchester, Hampshire, SO22 6NU		

SAP Rating	92 A	**DER**	10.61	**TER**	17.10
Environmental	90 B	**% DER<TER**	37.95		
CO_2 Emissions (t/year)	1.05	**DFEE**	54.90	**TFEE**	63.38
General Requirements Compliance	Pass	**% DFEE<TFEE**	13.37		

Assessor Details	Mr. Scott Spearing, Scott Spearing, Tel: 01489 565920, scott@beatsolutions.co.uk	**Assessor ID**	p775-0001
Client	Shorewood Homes Ltd, SHOREWOOD HOMES		

SUMARY FOR INPUT DATA FOR New Build (As Designed)

Criterion 1 – Achieving the TER and TFEE rate

1a TER and DER

Fuel for main heating	Mains gas		
Fuel factor	1.00 (mains gas)		
Target Carbon Dioxide Emission Rate (TER)	17.10	$kgCO_2/m^2$	
Dwelling Carbon Dioxide Emission Rate (DER)	10.61	$kgCO_2/m^2$	Pass
	-6.49 (-38.0%)	$kgCO_2/m^2$	

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)	63.38	$kWh/m^2/yr$	
Dwelling Fabric Energy Efficiency (DFEE)	54.90	$kWh/m^2/yr$	
	-8.5 (-13.4%)	$kWh/m^2/yr$	Pass

Criterion 2 – Limits on design flexibility

Limiting Fabric Standards

2 Fabric U-values

Element	Average	Highest	
External wall	0.18 (max. 0.30)	0.18 (max. 0.70)	Pass
Party wall	0.00 (max. 0.20)	-	Pass
Floor	0.13 (max. 0.25)	0.15 (max. 0.70)	Pass
Roof	0.11 (max. 0.20)	0.15 (max. 0.35)	Pass
Openings	1.40 (max. 2.00)	1.40 (max. 3.30)	Pass

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability

Air permeability at 50 pascals	5.00 (design value)	
Maximum	10.0	Pass

Limiting System Efficiencies

4 Heating efficiency

Main heating system	Boiler system with radiators or underfloor - Mains gas Data from database Worcester Greenstar 18i System ErP Efficiency: 89.7% SEDBUK2009 Minimum: 88.0%		Pass
Secondary heating system	None		

5 Cylinder insulation

Hot water storage	Measured cylinder loss: 1.95 kWh/day Permitted by DBSCG 2.30		Pass
Primary pipework insulated	Yes		Pass

6 Controls

Space heating controls	Time and temperature zone control		Pass
Hot water controls	Cylinderstat		Pass
	Independent timer for DHW		Pass
Boiler interlock	Yes		Pass

7 Low energy lights

Percentage of fixed lights with low-energy fittings	100	%	
Minimum	75	%	Pass

8 Mechanical ventilation

Not applicable

Criterion 3 – Limiting the effects of heat gains in summer

9 Summertime temperature

Overheating risk (Southern England)	Not significant		Pass

Based on:

Overshading	Average		
Windows facing North East	1.34 m², No overhang		
Windows facing South East	9.97 m², No overhang		
Windows facing South West	2.47 m², No overhang		
Windows facing North West	11.61 m², No overhang		
Air change rate	8.00 ach		
Blinds/curtains	None		

Criterion 4 – Building performance consistent with DER and DFEE rate

Party Walls

Type	U-value		
Filled Cavity with Edge Sealing	0.00	W/m²K	Pass

Air permeability and pressure testing

3 Air permeability

Air permeability at 50 pascals	5.00 (design value)		
Maximum	10.0		Pass

10 Key features

Party wall U-value	0.00	W/m²K
Roof U-value	0.10	W/m²K
Floor U-value	0.12	W/m²K
Photovoltaic array	2.50	kW

This report has not been submitted through the Elmhurst Energy members' portal, therefore results are subject to change when the dwelling is completed.

SUMMARY FOR INPUT DATA
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SUMMARY FOR INPUT DATA FOR: New Build (As Designed)

Orientation	North West
Property Tenure	Unknown
Transaction Type	New dwelling
Terrain Type	Suburban
1.0 Property Type	House, Semi-Detached
2.0 Number of Storeys	2
3.0 Date Built	2023
4.0 Sheltered Sides	0
5.0 Sunlight/Shade	Average or unknown

6.0 Measurements

	Heat Loss Perimeter	Internal Floor Area	Average Storey Height
Ground Floor:	38.59 m	66.18 m²	2.47 m
1st Storey:	34.40 m	82.86 m²	2.64 m

7.0 Living Area	15.47	m²
8.0 Thermal Mass Parameter	Precise calculation	
Thermal Mass	136.93	kJ/m²K

9.0 External Walls

Description	Type	Construction	U-Value (W/m²K)	Kappa (kJ/m²K)	Gross Area (m²)	Nett Area (m²)
External Wall	Cavity Wall	Cavity wall : plasterboard on dabs, AAC block, filled cavity, any outside structure	0.18	60.00	173.68	146.32
Dormer Walls	Timber Frame	Timber framed wall (one layer of plasterboard)	0.17	9.00	9.24	6.78

9.1 Party Walls

Description	Type	Construction	U-Value (W/m²K)	Kappa (kJ/m²K)	Area (m²)
Party Wall	Filled Cavity with Edge Sealing	Single plasterboard on dabs on both sides, dense blocks, cavity or cavity fill	0.00	70.00	10.56

9.2 Internal Walls

Description	Construction	Kappa (kJ/m²K)	Area (m²)
Internal Wall Masonary	Dense block, plasterboard on dabs	75.00	39.59
Internal Wall Timber	Plasterboard on timber frame	9.00	145.54

10.0 External Roofs

SUMMARY FOR INPUT DATA
Calculation Type: New Build (As Designed)

Design SAP
elmhurst energy

Description	Type	Construction	U-Value (W/m²K)	Kappa (kJ/m²K)	Gross Area (m²)	Nett Area (m²)
Bay Roof	External Flat Roof	Plasterboard, insulated flat roof	0.15	9.00	2.31	2.31
Flat Roof	External Flat Roof	Plasterboard, insulated flat roof	0.14	9.00	5.52	3.72
Pitched Cold Roof	External Plane Roof	Plasterboard, insulated at ceiling level	0.10	9.00	58.28	58.28
Pitched Sloping Roof	External Slope Roof	Plasterboard, insulated slope	0.13	9.00	18.46	18.46
Dormer Flat Roof	External Flat Roof	Plasterboard, insulated flat roof	0.13	9.00	3.07	3.07
Over Garage Flat Roof	External Flat Roof	Plasterboard, insulated flat roof	0.14	9.00	7.51	7.51

10.2 Internal Ceilings

Description	Construction	Kappa (kJ/m²K)	Area (m²)
Internal Ceiling	Plasterboard ceiling, carpeted chipboard floor	9.00	58.28

11.0 Heat Loss Floors

Description	Type	Construction	U-Value (W/m²K)	Kappa (kJ/m²K)	Area (m²)
Ground Floor	Ground Floor - Solid	Suspended concrete floor, carpeted	0.12	75.00	41.59
Exposed Floor	Exposed Floor - Timber	Timber exposed floor, insulation between joists	0.15	20.00	24.59

11.2 Internal Floors

Description	Construction	Kappa (kJ/m²K)	Area (m²)
Internal Floor	Plasterboard ceiling, carpeted chipboard floor	18.00	58.28

12.0 Opening Types

Description	Data Source	Type	Glazing	Glazing Gap	Argon Filled	G-value	Frame Type	Frame Factor	U Value (W/m²K)
Front Door	Manufacturer	Solid Door							1.40
Windows	Manufacturer	Window	Double Low-E Soft 0.05			0.63		0.70	1.40
Lantern Rooflight	Manufacturer	Roof Window	Double Low-E Soft 0.05			0.63		0.70	1.40
Garage Door	Manufacturer	Solid Door							1.40

13.0 Openings

Name	Opening Type	Location	Orientation	Curtain Type	Overhang Ratio	Wide Overhang	Width (m)	Height (m)	Count	Area (m²)	Curtain Closed
Front Door	Solid Door	[1] External Wall	North West							2.33	
Front Elevation	Window	[1] External Wall	North West	None	0.00					10.38	
Side Elevation	Window	[1] External Wall	North East	None	0.00					1.34	
Rear Elevation	Window	[1] External Wall	South East	None	0.00					8.74	
Side Elevation	Window	[1] External Wall	South West	None	0.00					2.47	
Lantern Rooflight	Roof Window	[2] Flat Roof	North	None						1.80	
Front Dormer	Window	[2] Dormer Walls	North West	None	0.00					1.23	
Rear Dormer	Window	[2] Dormer Walls	South East	None	0.00					1.23	
Garage Door	Solid Door	[1] External Wall	South West							2.10	

14.0 Conservatory	None	
15.0 Draught Proofing	100	%
16.0 Draught Lobby	No	
17.0 Thermal Bridging	Calculate Bridges	

17.1 List of Bridges

Source Type	Bridge Type	Length	Psi	Imported
Table K1 - Approved	E2 Other lintels (including other steel lintels)	17.76	0.300	No
Table K1 - Approved	E3 Sill	15.76	0.040	No
Table K1 - Approved	E4 Jamb	45.15	0.050	No
Table K1 - Approved	E5 Ground floor (normal)	38.59	0.160	Yes
Table K1 - Default	E20 Exposed floor (normal)	8.15	0.320	No
Table K1 - Default	E21 Exposed floor (inverted)	6.14	0.320	No
Table K1 - Approved	E6 Intermediate floor within a dwelling	26.25	0.070	No
Table K1 - Approved	E10 Eaves (insulation at ceiling level)	26.25	0.060	No
Table K1 - Default	E24 Eaves (insulation at ceiling level - inverted)	10.83	0.240	No
Table K1 - Approved	E11 Eaves (insulation at rafter level)	6.10	0.040	No
Table K1 - Default	E14 Flat roof	4.30	0.080	No
Table K1 - Default	E15 Flat roof with parapet	6.78	0.560	No
Table K1 - Approved	E16 Corner (normal)	41.91	0.090	No
Table K1 - Approved	E17 Corner (inverted – internal area greater than external area)	12.50	-0.090	No
Table K1 - Default	E25 Staggered party wall between dwellings	0.90	0.120	No
Table K1 - Default	P7 Party Wall - Exposed floor (normal)	6.04	0.160	No
Table K1 - Default	P4 Party wall - Roof (insulation at ceiling level)	1.96	0.240	No
Table K1 - Default	P5 Party wall - Roof (insulation at rafter level)	5.66	0.080	No
Table K1 - Default	R6 Flat ceiling	7.30	0.060	No

Y-value	0.100	W/m²K

18.0 Pressure Testing	Yes	
Designed AP_{50}	5.00	m³/(h.m²) @ 50 Pa
Property Tested ?		
As Built AP_{50}		m³/(h.m²) @ 50 Pa

19.0 Mechanical Ventilation

Summer Overheating

Windows open in hot weather	Windows fully open
Cross ventilation possible	Yes
Night Ventilation	No
Air change rate	8.00

Mechanical Ventilation

Mechanical Ventilation System Present	No

20.0 Fans, Open Fireplaces, Flues

	MHS	SHS	Other	Total
Number of Chimneys	0		0	0
Number of open flues	0		0	0
Number of intermittent fans				4
Number of passive vents				0
Number of flueless gas fires				0

21.0 Fixed Cooling System	No	

22.0 Lighting

Internal

Total number of light fittings	50	
Total number of L.E.L. fittings	50	
Percentage of L.E.L. fittings	100.00	%

External

External lights fitted	No	

23.0 Electricity Tariff	Standard	

24.0 Main Heating 1	Database	
Percentage of Heat	100	%
Database Ref. No.	17485	
Fuel Type	Mains gas	
Main Heating	BGB	
SAP Code	102	
In Winter	90.7	
In Summer	80.0	
Controls	CBI Time and temperature zone control	
PCDF Controls	0	
Delayed Start Stat	No	
Sap Code	2110	
Flue Type	Balanced	
Fan Assisted Flue	Yes	
Is MHS Pumped	in unheated space	
Heat Emitter	Radiators and Underfloor	
Underfloor Heating	Yes - Pipes in thin screed	
Flow Temperature	Unknown	
25.0 Main Heating 2	None	
Community Heating	None	
28.0 Water Heating	HWP From main heating 1	
Water Heating	Main Heating 1	
Flue Gas Heat Recovery System	No	
Waste Water Heat Recovery Instantaneous System 1	No	
Waste Water Heat Recovery Instantaneous System 2	No	
Waste Water Heat Recovery Storage System	No	
Solar Panel	No	
Water use <= 125 litres/person/day	Yes	
SAP Code	901	
29.0 Hot Water Cylinder	Hot Water Cylinder	
Cylinder Stat	Yes	
Cylinder In Heated Space	Yes	
Independent Time Control	Yes	
Insulation Type	Measured Loss	
Cylinder Volume	210.00	L
Loss	1.95	kWh/day
Pipes insulation	Fully insulated primary pipework	
31.0 Thermal Store	None	
32.0 Photovoltaic Unit	One Dwelling	

PV Cells kWp	Orientation	Elevation	Overshading	Connected to Dwelling
2.50	South West	30°	None Or Little	Yes

Recommendations

Lower cost measures

None

Further measures to achieve even higher standards

	Typical Cost	Typical savings per year	Ratings after improvement SAP rating	Environmental Impact
Solar water heating	£4,000 - £6,000	£116	A 93	

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

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CO_2 Emissions (t/year)	1.05	**DFEE**	54.90	**TFEE**	63.38
General Requirements Compliance	Pass	**% DFEE<TFEE**	13.37		

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REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

DWELLING AS DESIGNED

Semi-Detached House, total floor area 149 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 17.10 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 10.61 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)63.4 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)54.9 kWh/m²/yrOK

2 Fabric U-values

Element	Average	Highest	
External wall	0.18 (max. 0.30)	0.18 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.13 (max. 0.25)	0.15 (max. 0.70)	OK
Roof	0.11 (max. 0.20)	0.15 (max. 0.35)	OK
Openings	1.40 (max. 2.00)	1.40 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability
Air permeability at 50 pascals: 5.00 (design value)
Maximum 10.0 OK

4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Worcester Greenstar 18i System ErP

Efficiency: 89.7% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

5 Cylinder insulation
Hot water storage: Measured cylinder loss: 1.95 kWh/day
Permitted by DBSCG 2.30 OK
Primary pipework insulated: Yes OK

6 Controls
Space heating controls: Time and temperature zone control OK

Hot water controls: Cylinderstat OK
Independent timer for DHW OK

Boiler interlock: Yes OK

7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum: 75% OK

8 Mechanical ventilation
Not applicable

9 Summertime temperature
Overheating risk (Southern England): Not significant OK
Based on:
Overshading: Average
Windows facing North East: 1.34 m², No overhang
Windows facing South East: 9.97 m², No overhang
Windows facing South West: 2.47 m², No overhang
Windows facing North West: 11.61 m², No overhang
Air change rate: 8.00 ach
Blinds/curtains: None

10 Key features
Party wall U-value 0.00 W/m²K
Roof U-value 0.10 W/m²K
Floor U-value 0.12 W/m²K
Photovoltaic array 2.50 kW

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	66.1800	(1b)	x 2.4700	(2b) =	163.4646	(1b) - (3b)
First floor	82.8600	(1c)	x 2.6400	(2c) =	218.7504	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	149.0400					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		382.2150	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							4 * 10 =	40.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1047	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3547	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3547	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4522	0.4433	0.4345	0.3901	0.3813	0.3369	0.3369	0.3281	0.3547	0.3813	0.3990	0.4167	(22b)
Effective ac	0.6022	0.5983	0.5944	0.5761	0.5727	0.5568	0.5568	0.5538	0.5629	0.5727	0.5796	0.5868	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Front Door			2.3300	1.4000	3.2620			(26)
Windows (Uw = 1.40)			25.3900	1.3258	33.6610			(27)
Garage Door			2.1000	1.4000	2.9400			(26)
Lantern Rooflight (Uw = 1.40)			1.8000	1.3258	2.3864			(27a)
Ground Floor			41.5900	0.1200	4.9908	75.0000	3119.2500	(28a)
Exposed Floor			24.5900	0.1500	3.6885	20.0000	491.8000	(28b)
External Wall	173.6800	27.3600	146.3200	0.1800	26.3376	60.0000	8779.2000	(29a)
Dormer Walls	9.2400	2.4600	6.7800	0.1700	1.1526	9.0000	61.0200	(29a)
Bay Roof	2.3100		2.3100	0.1500	0.3465	9.0000	20.7900	(30)
Flat Roof	5.5200	1.8000	3.7200	0.1400	0.5208	9.0000	33.4800	(30)
Pitched Cold Roof	58.2800		58.2800	0.1000	5.8280	9.0000	524.5200	(30)
Pitched Sloping Roof	18.4600		18.4600	0.1300	2.3998	9.0000	166.1400	(30)
Dormer Flat Roof	3.0700		3.0700	0.1300	0.3991	9.0000	27.6300	(30)
Over Garage Flat Roof	7.5100		7.5100	0.1400	1.0514	9.0000	67.5900	(30)
Total net area of external elements Aum(A, m2)			344.2500					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	88.9644			(33)
Party Wall			10.5600	0.0000	0.0000	70.0000	739.2000	(32)
Internal Wall Masonary			39.5900			75.0000	2969.2500	(32c)
Internal Wall Timber			145.5400			9.0000	1309.8600	(32c)
Internal Floor			58.2800			18.0000	1049.0400	(32d)
Internal Ceiling			58.2800			18.0000	1049.0400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	20407.8100 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		136.9284 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		34.4421 (36)
Total fabric heat loss	(33) + (36) =	123.4065 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	75.9604	75.4597	74.9689	72.6636	72.2322	70.2244	70.2244	69.8526	70.9978	72.2322	73.1048	74.0170	(38)
Heat transfer coeff	199.3670	198.8662	198.3754	196.0701	195.6388	193.6309	193.6309	193.2591	194.4043	195.6388	196.5113	197.4236	(39)
Average = Sum(39)m / 12 =												196.0680	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3377	1.3343	1.3310	1.3156	1.3127	1.2992	1.2992	1.2967	1.3044	1.3127	1.3185	1.3246	(40)
HLP (average)												1.3155	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Assumed occupancy												2.9327	(42)
Average daily hot water use (litres/day)												103.8511	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	114.2363	110.0822	105.9282	101.7741	97.6201	93.4660	93.4660	97.6201	101.7741	105.9282	110.0822	114.2363	(44)
Energy conte	169.4091	148.1663	152.8943	133.2970	127.9016	110.3694	102.2734	117.3603	118.7619	138.4056	151.0805	164.0636	(45)
Energy content (annual)										Total = Sum(45)m =		1633.9829	(45)
Distribution loss (46)m = 0.15 x (45)m													
	25.4114	22.2249	22.9341	19.9945	19.1852	16.5554	15.3410	17.6040	17.8143	20.7608	22.6621	24.6095	(46)
Water storage loss:													
Store volume												210.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.9500	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												1.0530	(55)
Total storage loss													
	32.6430	29.4840	32.6430	31.5900	32.6430	31.5900	32.6430	32.6430	31.5900	32.6430	31.5900	32.6430	(56)
If cylinder contains dedicated solar storage													
	32.6430	29.4840	32.6430	31.5900	32.6430	31.5900	32.6430	32.6430	31.5900	32.6430	31.5900	32.6430	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month													
	225.3145	198.6615	208.7997	187.3990	183.8070	164.4714	158.1788	173.2657	172.8639	194.3110	205.1825	219.9690	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
									Solar input (sum of months) = Sum(63)m =			0.0000	(63)
Output from w/h													
	225.3145	198.6615	208.7997	187.3990	183.8070	164.4714	158.1788	173.2657	172.8639	194.3110	205.1825	219.9690	(64)
									Total per year (kWh/year) = Sum(64)m =			2292.2239	(64)
Heat gains from water heating, kWh/month													
	101.0528	89.6614	95.5617	87.6028	87.2516	79.9794	78.7302	83.7466	82.7699	90.7442	93.5159	99.2755	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	146.6340	146.6340	146.6340	146.6340	146.6340	146.6340	146.6340	146.6340	146.6340	146.6340	146.6340	146.6340	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	28.9697	25.7306	20.9256	15.8420	11.8421	9.9976	10.8027	14.0418	18.8469	23.9305	27.9304	29.7749	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	319.4766	322.7917	314.4376	296.6527	274.2024	253.1023	239.0062	235.6910	244.0451	261.8300	284.2803	305.3804	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.6634	37.6634	37.6634	37.6634	37.6634	37.6634	37.6634	37.6634	37.6634	37.6634	37.6634	37.6634	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-117.3072	-117.3072	-117.3072	-117.3072	-117.3072	-117.3072	-117.3072	-117.3072	-117.3072	-117.3072	-117.3072	-117.3072	(71)
Water heating gains (Table 5)													
	135.8237	133.4248	128.4431	121.6706	117.2737	111.0825	105.8202	112.5626	114.9582	121.9680	129.8831	133.4348	(72)
Total internal gains													
	551.2602	548.9373	530.7965	501.1555	470.3084	441.1726	422.6193	429.2857	444.8405	474.7187	509.0840	535.5803	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	1.3400	11.2829	0.6300	0.7000	0.7700	4.6206	(75)
Southeast	9.9700	36.7938	0.6300	0.7000	0.7700	112.1094	(77)
Southwest	2.4700	36.7938	0.6300	0.7000	0.7700	27.7743	(79)
Northwest	11.6100	11.2829	0.6300	0.7000	0.7700	40.0338	(81)
North	1.8000	26.0000	0.6300	0.7000	1.0000	18.5749	(82)

Solar gains	203.1130	367.7477	558.3652	780.0614	951.1456	977.4876	928.6389	796.4731	634.7147	421.5762	247.3111	171.1812	(83)
Total gains	754.3732	916.6850	1089.1617	1281.2169	1421.4540	1418.6602	1351.2582	1225.7588	1079.5551	896.2949	756.3951	706.7614	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	28.4342	28.5058	28.5763	28.9123	28.9760	29.2765	29.2765	29.3328	29.1600	28.9760	28.8474	28.7141	
alpha	2.8956	2.9004	2.9051	2.9275	2.9317	2.9518	2.9518	2.9555	2.9440	2.9317	2.9232	2.9143	
util living area													
	0.9895	0.9809	0.9622	0.9169	0.8292	0.6945	0.5593	0.6181	0.8210	0.9473	0.9829	0.9913	(86)
MIT	19.1030	19.2976	19.6280	20.0665	20.4577	20.7296	20.8410	20.8162	20.5879	20.0746	19.5123	19.0740	(87)
Th 2	19.8114	19.8141	19.8166	19.8287	19.8309	19.8415	19.8415	19.8434	19.8374	19.8309	19.8264	19.8216	(88)
util rest of house													
	0.9872	0.9768	0.9537	0.8971	0.7860	0.6122	0.4373	0.4981	0.7585	0.9310	0.9786	0.9894	(89)
MIT 2	17.2737	17.5583	18.0384	18.6719	19.2089	19.5566	19.6701	19.6533	19.3975	18.6961	17.8812	17.2382	(90)
Living area fraction									fLA = Living area / (4) =			0.1038	(91)
MIT	17.4636	17.7388	18.2034	18.8166	19.3385	19.6784	19.7916	19.7740	19.5211	18.8391	18.0505	17.4288	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.4636	17.7388	18.2034	18.8166	19.3385	19.6784	19.7916	19.7740	19.5211	18.8391	18.0505	17.4288	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Utilisation	0.9806	0.9665	0.9379	0.8752	0.7640	0.5989	0.4315	0.4900	0.7374	0.9118	0.9690	0.9837	(94)
Useful gains	739.7181	886.0062	1021.4954	1121.2726	1085.9967	849.6443	583.0933	600.5723	796.0627	817.2186	732.9216	695.2649	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	2624.3892	2553.2105	2321.6586	1944.3524	1494.3933	983.3305	617.9931	652.0650	1053.8824	1611.8955	2151.8927	2611.6760	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	1402.1953	1120.3613	967.3214	592.6174	303.8471	0.0000	0.0000	0.0000	0.0000	591.2396	1021.6592	1425.8098	(98)
Space heating												7425.0511	(98)
Space heating per m2											(98) / (4) =	49.8192	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.7000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												8186.3849	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	1402.1953	1120.3613	967.3214	592.6174	303.8471	0.0000	0.0000	0.0000	0.0000	591.2396	1021.6592	1425.8098	(98)
Space heating efficiency (main heating system 1)	90.7000	90.7000	90.7000	90.7000	90.7000	0.0000	0.0000	0.0000	0.0000	90.7000	90.7000	90.7000	(210)
Space heating fuel (main heating system)	1545.9705	1235.2385	1066.5065	653.3820	335.0023	0.0000	0.0000	0.0000	0.0000	651.8629	1126.4159	1572.0064	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	225.3145	198.6615	208.7997	187.3990	183.8070	164.4714	158.1788	173.2657	172.8639	194.3110	205.1825	219.9690	(64)
Efficiency of water heater												80.0000	(216)
(217)m	89.0511	88.9090	88.5963	87.8762	86.3470	80.0000	80.0000	80.0000	80.0000	87.7954	88.7155	89.1071	(217)
Fuel for water heating, kWh/month	253.0171	223.4436	235.6755	213.2533	212.8702	205.5892	197.7235	216.5821	216.0799	221.3225	231.2814	246.8592	(219)
Water heating fuel used												2673.6976	(219)
Annual totals kWh/year													
Space heating fuel - main system												8186.3849	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												511.6142	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 2.50 * 1029 * 1.00) =										-2058.3734		-2058.3734	(233)
Total delivered energy for all uses												9388.3233	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	8186.3849	0.2160	1768.2591	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2673.6976	0.2160	577.5187	(264)
Space and water heating			2345.7778	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	511.6142	0.5190	265.5278	(268)
Energy saving/generation technologies				
PV Unit	-2058.3734	0.5190	-1068.2958	(269)
Total CO2, kg/year			1581.9348	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			10.6100	(273)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

DER		10.6100	ZC1
Total Floor Area	TFA	149.0400	
Assumed number of occupants	N	2.9327	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		12.7023	ZC2
CO2 emissions from cooking, equation (L16)		1.2707	ZC3
Total CO2 emissions		24.5830	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		24.5830	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	66.1800 (1b)	x	2.4700 (2b)	=	163.4646	(1b) - (3b)
First floor	82.8600 (1c)	x	2.6400 (2c)	=	218.7504	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	149.0400					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	382.2150	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							4 * 10 =	40.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1047	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3547	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3547	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4522	0.4433	0.4345	0.3901	0.3813	0.3369	0.3369	0.3281	0.3547	0.3813	0.3990	0.4167	(22b)
Effective ac	0.6022	0.5983	0.5944	0.5761	0.5727	0.5568	0.5568	0.5538	0.5629	0.5727	0.5796	0.5868	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			4.4300	1.0000	4.4300			(26)
TER Opening Type (Uw = 1.40)			25.3900	1.3258	33.6610			(27)
TER Room Window (Uw = 1.70)			1.8000	1.5918	2.8652			(27a)
Ground Floor			41.5900	0.1300	5.4067			(28a)
Exposed Floor			24.5900	0.1300	3.1967			(28b)
External Wall	173.6800	27.3600	146.3200	0.1800	26.3376			(29a)
Dormer Walls	9.2400	2.4600	6.7800	0.1800	1.2204			(29a)
Bay Roof	2.3100		2.3100	0.1300	0.3003			(30)
Flat Roof	5.5200	1.8000	3.7200	0.1300	0.4836			(30)
Pitched Cold Roof	58.2800		58.2800	0.1300	7.5764			(30)
Pitched Sloping Roof	18.4600		18.4600	0.1300	2.3998			(30)
Dormer Flat Roof	3.0700		3.0700	0.1300	0.3991			(30)
Over Garage Flat Roof	7.5100		7.5100	0.1300	0.9763			(30)
Total net area of external elements Aum(A, m2)			344.2500					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		89.2531			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	28.0330	(36)
Total fabric heat loss (33) + (36) =	117.2861	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	75.9604	75.4597	74.9689	72.6636	72.2322	70.2244	70.2244	69.8526	70.9978	72.2322	73.1048	74.0170	(38)
Heat transfer coeff	193.2465	192.7458	192.2549	189.9496	189.5183	187.5104	187.5104	187.1386	188.2838	189.5183	190.3908	191.3031	(39)
Average = Sum(39)m / 12 =												189.9475	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2966	1.2932	1.2900	1.2745	1.2716	1.2581	1.2581	1.2556	1.2633	1.2716	1.2774	1.2836	(40)
HLP (average)												1.2745	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.9327 (42)
Average daily hot water use (litres/day)	103.8511 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	114.2363	110.0822	105.9282	101.7741	97.6201	93.4660	93.4660	97.6201	101.7741	105.9282	110.0822	114.2363	(44)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Energy conte	169.4091	148.1663	152.8943	133.2970	127.9016	110.3694	102.2734	117.3603	118.7619	138.4056	151.0805	164.0636	(45)
Energy content (annual)										Total = Sum(45)m =		1633.9829	(45)
Distribution loss (46)m = 0.15 x (45)m													
	25.4114	22.2249	22.9341	19.9945	19.1852	16.5554	15.3410	17.6040	17.8143	20.7608	22.6621	24.6095	(46)
Water storage loss:													
Store volume												210.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.7016	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.9188	(55)
Total storage loss													
	28.4842	25.7277	28.4842	27.5653	28.4842	27.5653	28.4842	28.4842	27.5653	28.4842	27.5653	28.4842	(56)
If cylinder contains dedicated solar storage													
	28.4842	25.7277	28.4842	27.5653	28.4842	27.5653	28.4842	28.4842	27.5653	28.4842	27.5653	28.4842	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month													
	221.1557	194.9051	204.6409	183.3743	179.6482	160.4467	154.0200	169.1069	168.8393	190.1522	201.1578	215.8102	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	221.1557	194.9051	204.6409	183.3743	179.6482	160.4467	154.0200	169.1069	168.8393	190.1522	201.1578	215.8102	(64)
								Total per year (kWh/year) = Sum(64)m =				2243.2573	(64)
Heat gains from water heating, kWh/month													
	97.7258	86.6564	92.2346	84.3831	83.9246	76.7597	75.4032	80.4196	79.5502	87.4171	90.2961	95.9484	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	146.6340	146.6340	146.6340	146.6340	146.6340	146.6340	146.6340	146.6340	146.6340	146.6340	146.6340	146.6340	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	28.9697	25.7306	20.9256	15.8420	11.8421	9.9976	10.8027	14.0418	18.8469	23.9305	27.9304	29.7749	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	319.4766	322.7917	314.4376	296.6527	274.2024	253.1023	239.0062	235.6910	244.0451	261.8300	284.2803	305.3804	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.6634	37.6634	37.6634	37.6634	37.6634	37.6634	37.6634	37.6634	37.6634	37.6634	37.6634	37.6634	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-117.3072	-117.3072	-117.3072	-117.3072	-117.3072	-117.3072	-117.3072	-117.3072	-117.3072	-117.3072	-117.3072	-117.3072	(71)
Water heating gains (Table 5)													
	131.3519	128.9529	123.9713	117.1988	112.8018	106.6107	101.3484	108.0908	110.4864	117.4961	125.4113	128.9629	(72)
Total internal gains													
	549.7883	547.4655	529.3246	499.6837	468.8365	439.7008	421.1475	427.8138	443.3686	473.2468	507.6122	534.1084	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	1.3400	11.2829	0.6300	0.7000	0.7700	4.6206	(75)
Southeast	9.9700	36.7938	0.6300	0.7000	0.7700	112.1094	(77)
Southwest	2.4700	36.7938	0.6300	0.7000	0.7700	27.7743	(79)
Northwest	11.6100	11.2829	0.6300	0.7000	0.7700	40.0338	(81)
North	1.8000	26.0000	0.6300	0.7000	1.0000	18.5749	(82)

Solar gains	203.1130	367.7477	558.3652	780.0614	951.1456	977.4876	928.6389	796.4731	634.7147	421.5762	247.3111	171.1812	(83)
Total gains	752.9014	915.2132	1087.6898	1279.7450	1419.9822	1417.1884	1349.7864	1224.2869	1078.0833	894.8230	754.9233	705.2896	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	53.5585	53.6977	53.8348	54.4881	54.6121	55.1969	55.1969	55.3066	54.9702	54.6121	54.3619	54.1026	
alpha	4.5706	4.5798	4.5890	4.6325	4.6408	4.6798	4.6798	4.6871	4.6647	4.6408	4.6241	4.6068	
util living area													
	0.9990	0.9974	0.9918	0.9695	0.8988	0.7493	0.5860	0.6568	0.8907	0.9859	0.9978	0.9993	(86)
MIT	19.4809	19.6548	19.9499	20.3483	20.7002	20.9146	20.9789	20.9650	20.7908	20.3288	19.8341	19.4565	(87)
Th 2	19.8435	19.8461	19.8487	19.8609	19.8632	19.8738	19.8738	19.8758	19.8697	19.8632	19.8585	19.8537	(88)
util rest of house													
	0.9987	0.9964	0.9887	0.9568	0.8561	0.6528	0.4485	0.5181	0.8266	0.9780	0.9969	0.9990	(89)
MIT 2	17.8193	18.0752	18.5069	19.0869	19.5638	19.8161	19.8661	19.8611	19.6932	19.0682	18.3463	17.7904	(90)
Living area fraction									fLA = Living area / (4) =			0.1038	(91)
MIT	17.9917	18.2392	18.6566	19.2179	19.6818	19.9301	19.9816	19.9757	19.8071	19.1991	18.5008	17.9633	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.9917	18.2392	18.6566	19.2179	19.6818	19.9301	19.9816	19.9757	19.8071	19.1991	18.5008	17.9633	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9977	0.9943	0.9838	0.9470	0.8477	0.6582	0.4624	0.5315	0.8221	0.9711	0.9951	0.9983	(94)
Useful gains	751.1757	909.9974	1070.0607	1211.9414	1203.7237	932.8102	624.1554	650.6759	886.3084	868.9677	751.1869	704.0935	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	2645.8791	2571.0673	2337.1752	1959.8735	1512.6976	999.4540	634.0886	669.1493	1074.5546	1629.6801	2170.5989	2632.9685	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

	1409.6593	1116.2390	942.7333	538.5111	229.8766	0.0000	0.0000	0.0000	0.0000	565.9701	1021.9766	1435.0830 (98)
Space heating												7260.0489 (98)
Space heating per m2											(98) / (4) =	48.7121 (99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000 (201)
Fraction of space heat from main system(s)	1.0000 (202)
Efficiency of main space heating system 1 (in %)	93.5000 (206)
Efficiency of secondary/supplementary heating system, %	0.0000 (208)
Space heating requirement	7764.7582 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	1409.6593	1116.2390	942.7333	538.5111	229.8766	0.0000	0.0000	0.0000	0.0000	565.9701	1021.9766	1435.0830	(98)
Space heating efficiency (main heating system 1)													
	93.5000	93.5000	93.5000	93.5000	93.5000	0.0000	0.0000	0.0000	0.0000	93.5000	93.5000	93.5000	(210)
Space heating fuel (main heating system)													
	1507.6570	1193.8385	1008.2709	575.9477	245.8573	0.0000	0.0000	0.0000	0.0000	605.3156	1093.0231	1534.8482	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	221.1557	194.9051	204.6409	183.3743	179.6482	160.4467	154.0200	169.1069	168.8393	190.1522	201.1578	215.8102	(64)
Efficiency of water heater												79.8000	(216)
(217)m	88.8838	88.7314	88.3863	87.5191	85.4725	79.8000	79.8000	79.8000	79.8000	87.5479	88.5474	88.9410	(217)
Fuel for water heating, kWh/month													
	248.8144	219.6574	231.5302	209.5250	210.1824	201.0610	193.0076	211.9134	211.5780	217.1979	227.1754	242.6442	(219)
Water heating fuel used												2624.2869	(219)
Annual totals kWh/year													
Space heating fuel - main system												7764.7582	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												511.6142	(232)
Total delivered energy for all uses												10975.6593	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	7764.7582	0.2160	1677.1878	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2624.2869	0.2160	566.8460	(264)
Space and water heating			2244.0337	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	511.6142	0.5190	265.5278	(268)
Total CO2, kg/m2/year			2548.4865	(272)
Emissions per m2 for space and water heating			15.0566	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			1.7816	(272b)
Emissions per m2 for pumps and fans			0.2612	(272c)
Target Carbon Dioxide Emission Rate (TER) = (15.0566 * 1.00) + 1.7816 + 0.2612, rounded to 2 d.p.			17.1000	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	66.1800	(1b)	x 2.4700	(2b) =	163.4646	(1b) - (3b)
First floor	82.8600	(1c)	x 2.6400	(2c) =	218.7504	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	149.0400					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	382.2150	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1047	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3547	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3547	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4522	0.4433	0.4345	0.3901	0.3813	0.3369	0.3369	0.3281	0.3547	0.3813	0.3990	0.4167	(22b)
Effective ac	0.6022	0.5983	0.5944	0.5761	0.5727	0.5568	0.5568	0.5538	0.5629	0.5727	0.5796	0.5868	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Front Door			2.3300	1.4000	3.2620			(26)
Windows (Uw = 1.40)			25.3900	1.3258	33.6610			(27)
Garage Door			2.1000	1.4000	2.9400			(26)
Lantern Rooflight (Uw = 1.40)			1.8000	1.3258	2.3864			(27a)
Ground Floor			41.5900	0.1200	4.9908	75.0000	3119.2500	(28a)
Exposed Floor			24.5900	0.1500	3.6885	20.0000	491.8000	(28b)
External Wall	173.6800	27.3600	146.3200	0.1800	26.3376	60.0000	8779.2000	(29a)
Dormer Walls	9.2400	2.4600	6.7800	0.1700	1.1526	9.0000	61.0200	(29a)
Bay Roof	2.3100		2.3100	0.1500	0.3465	9.0000	20.7900	(30)
Flat Roof	5.5200	1.8000	3.7200	0.1400	0.5208	9.0000	33.4800	(30)
Pitched Cold Roof	58.2800		58.2800	0.1000	5.8280	9.0000	524.5200	(30)
Pitched Sloping Roof	18.4600		18.4600	0.1300	2.3998	9.0000	166.1400	(30)
Dormer Flat Roof	3.0700		3.0700	0.1300	0.3991	9.0000	27.6300	(30)
Over Garage Flat Roof	7.5100		7.5100	0.1400	1.0514	9.0000	67.5900	(30)
Total net area of external elements Aum(A, m2)			344.2500					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	88.9644			(33)
Party Wall			10.5600	0.0000	0.0000	70.0000	739.2000	(32)
Internal Wall Masonary			39.5900			75.0000	2969.2500	(32c)
Internal Wall Timber			145.5400			9.0000	1309.8600	(32c)
Internal Floor			58.2800			18.0000	1049.0400	(32d)
Internal Ceiling			58.2800			9.0000	524.5200	(32e)
Heat capacity Cm = Sum(A x k)				(28)...(30) + (32) + (32a)...(32e) =			19883.2900	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							133.4091	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							34.4421	(36)
Total fabric heat loss					(33) + (36) =		123.4065	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	75.9604	75.4597	74.9689	72.6636	72.2322	70.2244	70.2244	69.8526	70.9978	72.2322	73.1048	74.0170	(38)
Heat transfer coeff	199.3670	198.8662	198.3754	196.0701	195.6388	193.6309	193.6309	193.2591	194.4043	195.6388	196.5113	197.4236	(39)
Average = Sum(39)m / 12 =												196.0680	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3377	1.3343	1.3310	1.3156	1.3127	1.2992	1.2992	1.2967	1.3044	1.3127	1.3185	1.3246	(40)
HLP (average)												1.3155	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Assumed occupancy												2.9327	(42)
Average daily hot water use (litres/day)												103.8511	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	114.2363	110.0822	105.9282	101.7741	97.6201	93.4660	93.4660	97.6201	101.7741	105.9282	110.0822	114.2363	(44)
Energy conte	169.4091	148.1663	152.8943	133.2970	127.9016	110.3694	102.2734	117.3603	118.7619	138.4056	151.0805	164.0636	(45)
Energy content (annual)										Total = Sum(45)m =		1633.9829	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month	35.9994	31.4853	32.4900	28.3256	27.1791	23.4535	21.7331	24.9391	25.2369	29.4112	32.1046	34.8635	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	146.6340	146.6340	146.6340	146.6340	146.6340	146.6340	146.6340	146.6340	146.6340	146.6340	146.6340	146.6340	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	28.9697	25.7306	20.9256	15.8420	11.8421	9.9976	10.8027	14.0418	18.8469	23.9305	27.9304	29.7749	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	319.4766	322.7917	314.4376	296.6527	274.2024	253.1023	239.0062	235.6910	244.0451	261.8300	284.2803	305.3804	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.6634	37.6634	37.6634	37.6634	37.6634	37.6634	37.6634	37.6634	37.6634	37.6634	37.6634	37.6634	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-117.3072	-117.3072	-117.3072	-117.3072	-117.3072	-117.3072	-117.3072	-117.3072	-117.3072	-117.3072	-117.3072	-117.3072	(71)
Water heating gains (Table 5)	48.3863	46.8532	43.6694	39.3411	36.5310	32.5743	29.2112	33.5202	35.0513	39.5312	44.5897	46.8596	(72)
Total internal gains	463.8228	462.3657	446.0228	418.8260	389.5657	362.6644	346.0103	350.2433	364.9335	392.2819	423.7906	449.0050	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	1.3400	11.2829	0.6300	0.7000	0.7700	4.6206	(75)
Southeast	9.9700	36.7938	0.6300	0.7000	0.7700	112.1094	(77)
Southwest	2.4700	36.7938	0.6300	0.7000	0.7700	27.7743	(79)
Northwest	11.6100	11.2829	0.6300	0.7000	0.7700	40.0338	(81)
North	1.8000	26.0000	0.6300	0.7000	1.0000	18.5749	(82)

Solar gains	203.1130	367.7477	558.3652	780.0614	951.1456	977.4876	928.6389	796.4731	634.7147	421.5762	247.3111	171.1812	(83)
Total gains	666.9358	830.1134	1004.3880	1198.8874	1340.7114	1340.1520	1274.6492	1146.7164	999.6482	813.8580	671.1017	620.1862	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	27.7034	27.7731	27.8418	28.1692	28.2313	28.5240	28.5240	28.5789	28.4106	28.2313	28.1059	27.9761	
alpha	2.8469	2.8515	2.8561	2.8779	2.8821	2.9016	2.9016	2.9053	2.8940	2.8821	2.8737	2.8651	
util living area	0.9918	0.9841	0.9672	0.9253	0.8428	0.7139	0.5815	0.6432	0.8405	0.9560	0.9866	0.9933	(86)
MIT	18.4738	18.7398	19.1929	19.7968	20.3427	20.7297	20.8940	20.8550	20.5210	19.8019	19.0302	18.4337	(87)
Th 2	19.8114	19.8141	19.8166	19.8287	19.8309	19.8415	19.8415	19.8434	19.8374	19.8309	19.8264	19.8216	(88)
util rest of house	0.9900	0.9808	0.9599	0.9074	0.8021	0.6334	0.4583	0.5234	0.7824	0.9421	0.9832	0.9919	(89)
MIT 2	17.5085	17.7748	18.2253	18.8238	19.3396	19.6825	19.7998	19.7809	19.5189	18.8402	18.0740	17.4755	(90)
Living area fraction										fLA = Living area / (4) =		0.1038	(91)
MIT	17.6087	17.8750	18.3257	18.9248	19.4437	19.7912	19.9134	19.8924	19.6230	18.9400	18.1732	17.5750	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.6087	17.8750	18.3257	18.9248	19.4437	19.7912	19.9134	19.8924	19.6230	18.9400	18.1732	17.5750	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9852	0.9729	0.9473	0.8898	0.7859	0.6294	0.4667	0.5292	0.7691	0.9276	0.9762	0.9879	(94)
Useful gains	657.0909	807.6424	951.4504	1066.7439	1053.6314	843.4750	594.8965	606.8064	768.8473	754.9514	655.1389	612.6829	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	2653.3139	2580.2799	2345.9311	1965.5583	1514.9669	1005.1807	641.5747	674.9412	1073.6877	1631.6350	2176.0128	2640.5343	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	1485.1899	1191.2124	1037.4936	647.1464	343.2336	0.0000	0.0000	0.0000	0.0000	652.2526	1095.0292	1508.7214	(98)
Space heating												7960.2792	(98)
Space heating per m2											(98) / (4) =	53.4104	(99)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	1820.1307	1432.8689	1468.7692	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7104	0.7810	0.7382	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1292.9891	1119.0168	1084.3167	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1667.9100	1589.7516	1446.5906	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	269.9430	350.2267	269.5317	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												889.7014	(104)
Cooled fraction										fC = cooled area / (4) =		1.0000	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	67.4858	87.5567	67.3829	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												222.4254	(107)
Space cooling per m2												1.4924	(108)
Energy for space heating												53.4104	(99)
Energy for space cooling												1.4924	(108)
Total												54.9027	(109)
Dwelling Fabric Energy Efficiency (DFEE)												54.9	(109)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	66.1800	(1b)	x 2.4700	(2b) =	163.4646	(1b) - (3b)
First floor	82.8600	(1c)	x 2.6400	(2c) =	218.7504	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	149.0400					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	382.2150	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							4 * 10 =	40.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1047	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3547	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3547	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4522	0.4433	0.4345	0.3901	0.3813	0.3369	0.3369	0.3281	0.3547	0.3813	0.3990	0.4167	(22b)
Effective ac	0.6022	0.5983	0.5944	0.5761	0.5727	0.5568	0.5568	0.5538	0.5629	0.5727	0.5796	0.5868	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			4.4300	1.0000	4.4300			(26)
TER Opening Type (Uw = 1.40)			25.3900	1.3258	33.6610			(27)
TER Room Window (Uw = 1.70)			1.8000	1.5918	2.8652			(27a)
Ground Floor			41.5900	0.1300	5.4067			(28a)
Exposed Floor			24.5900	0.1300	3.1967			(28b)
External Wall	173.6800	27.3600	146.3200	0.1800	26.3376			(29a)
Dormer Walls	9.2400	2.4600	6.7800	0.1800	1.2204			(29a)
Bay Roof	2.3100		2.3100	0.1300	0.3003			(30)
Flat Roof	5.5200	1.8000	3.7200	0.1300	0.4836			(30)
Pitched Cold Roof	58.2800		58.2800	0.1300	7.5764			(30)
Pitched Sloping Roof	18.4600		18.4600	0.1300	2.3998			(30)
Dormer Flat Roof	3.0700		3.0700	0.1300	0.3991			(30)
Over Garage Flat Roof	7.5100		7.5100	0.1300	0.9763			(30)
Total net area of external elements Aum(A, m2)			344.2500					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		89.2531			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	28.0330	(36)
Total fabric heat loss (33) + (36) =	117.2861	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	75.9604	75.4597	74.9689	72.6636	72.2322	70.2244	70.2244	69.8526	70.9978	72.2322	73.1048	74.0170	(38)
Heat transfer coeff	193.2465	192.7458	192.2549	189.9496	189.5183	187.5104	187.5104	187.1386	188.2838	189.5183	190.3908	191.3031	(39)
Average = Sum(39)m / 12 =												189.9475	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2966	1.2932	1.2900	1.2745	1.2716	1.2581	1.2581	1.2556	1.2633	1.2716	1.2774	1.2836	(40)
HLP (average)												1.2745	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.9327 (42)
Average daily hot water use (litres/day)	103.8511 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	114.2363	110.0822	105.9282	101.7741	97.6201	93.4660	93.4660	97.6201	101.7741	105.9282	110.0822	114.2363	(44)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Energy conte	169.4091	148.1663	152.8943	133.2970	127.9016	110.3694	102.2734	117.3603	118.7619	138.4056	151.0805	164.0636	(45)
Energy content (annual)										Total = Sum(45)m =		1633.9829	(45)
Distribution loss (46)m = 0.15 x (45)m													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	35.9994	31.4853	32.4900	28.3256	27.1791	23.4535	21.7331	24.9391	25.2369	29.4112	32.1046	34.8635	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	146.6340	146.6340	146.6340	146.6340	146.6340	146.6340	146.6340	146.6340	146.6340	146.6340	146.6340	146.6340	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	28.9697	25.7306	20.9256	15.8420	11.8421	9.9976	10.8027	14.0418	18.8469	23.9305	27.9304	29.7749	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	319.4766	322.7917	314.4376	296.6527	274.2024	253.1023	239.0062	235.6910	244.0451	261.8300	284.2803	305.3804	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.6634	37.6634	37.6634	37.6634	37.6634	37.6634	37.6634	37.6634	37.6634	37.6634	37.6634	37.6634	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-117.3072	-117.3072	-117.3072	-117.3072	-117.3072	-117.3072	-117.3072	-117.3072	-117.3072	-117.3072	-117.3072	-117.3072	(71)
Water heating gains (Table 5)													
	48.3863	46.8532	43.6694	39.3411	36.5310	32.5743	29.2112	33.5202	35.0513	39.5312	44.5897	46.8596	(72)
Total internal gains													
	463.8228	462.3657	446.0228	418.8260	389.5657	362.6644	346.0103	350.2433	364.9335	392.2819	423.7906	449.0050	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	1.3400	11.2829	0.6300	0.7000	0.7700	4.6206	(75)
Southeast	9.9700	36.7938	0.6300	0.7000	0.7700	112.1094	(77)
Southwest	2.4700	36.7938	0.6300	0.7000	0.7700	27.7743	(79)
Northwest	11.6100	11.2829	0.6300	0.7000	0.7700	40.0338	(81)
North	1.8000	26.0000	0.6300	0.7000	1.0000	18.5749	(82)

Solar gains	203.1130	367.7477	558.3652	780.0614	951.1456	977.4876	928.6389	796.4731	634.7147	421.5762	247.3111	171.1812	(83)
Total gains	666.9358	830.1134	1004.3880	1198.8874	1340.7114	1340.1520	1274.6492	1146.7164	999.6482	813.8580	671.1017	620.1862	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	53.5585	53.6977	53.8348	54.4881	54.6121	55.1969	55.1969	55.3066	54.9702	54.6121	54.3619	54.1026	
alpha	4.5706	4.5798	4.5890	4.6325	4.6408	4.6798	4.6798	4.6871	4.6647	4.6408	4.6241	4.6068	
util living area													
	0.9994	0.9983	0.9941	0.9759	0.9145	0.7756	0.6147	0.6900	0.9122	0.9903	0.9987	0.9996	(86)
MIT	19.4284	19.6032	19.9005	20.3047	20.6693	20.9007	20.9743	20.9570	20.7609	20.2818	19.7830	19.4043	(87)
Th 2	19.8435	19.8461	19.8487	19.8609	19.8632	19.8738	19.8738	19.8758	19.8697	19.8632	19.8585	19.8537	(88)
util rest of house													
	0.9992	0.9976	0.9917	0.9656	0.8761	0.6812	0.4733	0.5493	0.8559	0.9847	0.9981	0.9994	(89)
MIT 2	18.4090	18.5855	18.8838	19.2913	19.6335	19.8268	19.8672	19.8630	19.7272	19.2749	18.7751	18.3928	(90)
Living area fraction										fLA = Living area / (4) =		0.1038	(91)
MIT	18.5148	18.6912	18.9894	19.3965	19.7410	19.9383	19.9822	19.9766	19.8345	19.3794	18.8797	18.4978	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.5148	18.6912	18.9894	19.3965	19.7410	19.9383	19.9822	19.9766	19.8345	19.3794	18.8797	18.4978	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9988	0.9967	0.9893	0.9599	0.8710	0.6873	0.4878	0.5632	0.8536	0.9812	0.9974	0.9992	(94)
Useful gains	666.1531	827.3444	993.6000	1150.8530	1167.8077	921.0932	621.8060	645.8811	853.3322	798.5359	669.3241	619.6710	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	2746.9546	2658.1900	2401.1399	1993.8019	1523.9256	1000.9824	634.1899	669.3190	1079.7162	1663.8626	2242.7500	2735.2162	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	1548.1163	1230.3283	1047.2097	606.9232	264.9517	0.0000	0.0000	0.0000	0.0000	643.8031	1132.8667	1573.9656	(98)
Space heating												8048.1647	(98)
Space heating per m2											(98) / (4) =	54.0000	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	1762.5981	1387.5772	1422.2534	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8004	0.8750	0.8311	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1410.8678	1214.0812	1182.0089	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1667.9100	1589.7516	1446.5906	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	185.0703	279.4988	196.8488	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												661.4179	(104)
Cooled fraction											fC = cooled area / (4) =	1.0000	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	46.2676	69.8747	49.2122	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												165.3545	(107)
Space cooling per m2												1.1095	(108)
Energy for space heating												54.0000	(99)
Energy for space cooling												1.1095	(108)
Total												55.1095	(109)
Target Fabric Energy Efficiency (TFEE)												63.4	(109)

CALCULATION OF HEAT DEMAND 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF HEAT DEMAND 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	66.1800	(1b)	x 2.4700	(2b) =	163.4646	(1b) - (3b)
First floor	82.8600	(1c)	x 2.6400	(2c) =	218.7504	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	149.0400					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	382.2150	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1047	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3547	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3547	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.1000	3.8000	3.9000	3.7000	3.6000	3.3000	3.3000	3.2000	3.2000	3.4000	3.3000	3.7000	(22)
Wind factor	1.0250	0.9500	0.9750	0.9250	0.9000	0.8250	0.8250	0.8000	0.8000	0.8500	0.8250	0.9250	(22a)
Adj infilt rate	0.3635	0.3369	0.3458	0.3281	0.3192	0.2926	0.2926	0.2837	0.2837	0.3015	0.2926	0.3281	(22b)
Effective ac	0.5661	0.5568	0.5598	0.5538	0.5509	0.5428	0.5428	0.5402	0.5402	0.5454	0.5428	0.5538	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Front Door			2.3300	1.4000	3.2620			(26)
Windows (Uw = 1.40)			25.3900	1.3258	33.6610			(27)
Garage Door			2.1000	1.4000	2.9400			(26)
Lantern Rooflight (Uw = 1.40)			1.8000	1.3258	2.3864			(27a)
Ground Floor			41.5900	0.1200	4.9908	75.0000	3119.2500	(28a)
Exposed Floor			24.5900	0.1500	3.6885	20.0000	491.8000	(28b)
External Wall	173.6800	27.3600	146.3200	0.1800	26.3376	60.0000	8779.2000	(29a)
Dormer Walls	9.2400	2.4600	6.7800	0.1700	1.1526	9.0000	61.0200	(29a)
Bay Roof	2.3100		2.3100	0.1500	0.3465	9.0000	20.7900	(30)
Flat Roof	5.5200	1.8000	3.7200	0.1400	0.5208	9.0000	33.4800	(30)
Pitched Cold Roof	58.2800		58.2800	0.1000	5.8280	9.0000	524.5200	(30)
Pitched Sloping Roof	18.4600		18.4600	0.1300	2.3998	9.0000	166.1400	(30)
Dormer Flat Roof	3.0700		3.0700	0.1300	0.3991	9.0000	27.6300	(30)
Over Garage Flat Roof	7.5100		7.5100	0.1400	1.0514	9.0000	67.5900	(30)
Total net area of external elements Aum(A, m2)			344.2500					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	88.9644			(33)
Party Wall			10.5600	0.0000	0.0000	70.0000	739.2000	(32)
Internal Wall Masonary			39.5900			75.0000	2969.2500	(32c)
Internal Wall Timber			145.5400			9.0000	1309.8600	(32c)
Internal Floor			58.2800			18.0000	1049.0400	(32d)
Internal Ceiling			58.2800			18.0000	1049.0400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	20407.8100 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		136.9284 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		34.4421 (36)
Total fabric heat loss	(33) + (36) =	123.4065 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	71.3994	70.2244	70.6061	69.8526	69.4906	68.4644	68.4644	68.1421	68.1421	68.7966	68.4644	69.8526	(38)
Heat transfer coeff	194.8059	193.6309	194.0127	193.2591	192.8972	191.8709	191.8709	191.5487	191.5487	192.2031	191.8709	193.2591	(39)
Average = Sum(39)m / 12 =												192.7315	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3071	1.2992	1.3017	1.2967	1.2943	1.2874	1.2874	1.2852	1.2852	1.2896	1.2874	1.2967	(40)
HLP (average)												1.2932	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

CALCULATION OF HEAT DEMAND 09 Jan 2014

Assumed occupancy												2.9327	(42)
Average daily hot water use (litres/day)												103.8511	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	114.2363	110.0822	105.9282	101.7741	97.6201	93.4660	93.4660	97.6201	101.7741	105.9282	110.0822	114.2363	(44)
Energy conte	169.4091	148.1663	152.8943	133.2970	127.9016	110.3694	102.2734	117.3603	118.7619	138.4056	151.0805	164.0636	(45)
Energy content (annual)										Total = Sum(45)m =		1633.9829	(45)
Distribution loss (46)m = 0.15 x (45)m													
	25.4114	22.2249	22.9341	19.9945	19.1852	16.5554	15.3410	17.6040	17.8143	20.7608	22.6621	24.6095	(46)
Water storage loss:													
Store volume												210.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.9500	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												1.0530	(55)
Total storage loss													
	32.6430	29.4840	32.6430	31.5900	32.6430	31.5900	32.6430	32.6430	31.5900	32.6430	31.5900	32.6430	(56)
If cylinder contains dedicated solar storage													
	32.6430	29.4840	32.6430	31.5900	32.6430	31.5900	32.6430	32.6430	31.5900	32.6430	31.5900	32.6430	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month													
	225.3145	198.6615	208.7997	187.3990	183.8070	164.4714	158.1788	173.2657	172.8639	194.3110	205.1825	219.9690	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
									Solar input (sum of months) = Sum(63)m =			0.0000	(63)
Output from w/h													
	225.3145	198.6615	208.7997	187.3990	183.8070	164.4714	158.1788	173.2657	172.8639	194.3110	205.1825	219.9690	(64)
									Total per year (kWh/year) = Sum(64)m =			2292.2239	(64)
RHI water heating demand												2292	(64)
Heat gains from water heating, kWh/month													
	101.0528	89.6614	95.5617	87.6028	87.2516	79.9794	78.7302	83.7466	82.7699	90.7442	93.5159	99.2755	(65)

5. Internal gains (see Table 5 and 5a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	175.9608	175.9608	175.9608	175.9608	175.9608	175.9608	175.9608	175.9608	175.9608	175.9608	175.9608	175.9608	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	72.4243	64.3266	52.3139	39.6050	29.6052	24.9940	27.0069	35.1045	47.1172	59.8261	69.8259	74.4372	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	476.8307	481.7787	469.3099	442.7652	409.2573	377.7647	356.7256	351.7776	364.2465	390.7911	424.2990	455.7916	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	55.5288	55.5288	55.5288	55.5288	55.5288	55.5288	55.5288	55.5288	55.5288	55.5288	55.5288	55.5288	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-117.3072	-117.3072	-117.3072	-117.3072	-117.3072	-117.3072	-117.3072	-117.3072	-117.3072	-117.3072	-117.3072	-117.3072	(71)
Water heating gains (Table 5)													
	135.8237	133.4248	128.4431	121.6706	117.2737	111.0825	105.8202	112.5626	114.9582	121.9680	129.8831	133.4348	(72)
Total internal gains													
	799.2610	793.7124	764.2492	718.2232	670.3186	628.0235	603.7351	613.6272	640.5043	686.7676	738.1904	777.8460	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	1.3400	14.6223	0.6300	0.7000	0.7700	5.9882	(75)
Southeast	9.9700	45.2918	0.6300	0.7000	0.7700	138.0023	(77)
Southwest	2.4700	45.2918	0.6300	0.7000	0.7700	34.1891	(79)
Northwest	11.6100	14.6223	0.6300	0.7000	0.7700	51.8825	(81)
North	1.8000	34.0000	0.6300	0.7000	1.0000	24.2903	(82)

Solar gains	254.3523	393.2957	599.5238	844.4701	977.7732	1093.7885	1020.2135	896.9490	717.3407	481.2241	301.7977	202.7421	(83)
Total gains	1053.6133	1187.0081	1363.7731	1562.6933	1648.0918	1721.8120	1623.9485	1510.5762	1357.8450	1167.9917	1039.9881	980.5881	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	29.0999	29.2765	29.2189	29.3328	29.3879	29.5450	29.5450	29.5948	29.5948	29.4940	29.5450	29.3328	
alpha	2.9400	2.9518	2.9479	2.9555	2.9592	2.9697	2.9697	2.9730	2.9730	2.9663	2.9697	2.9555	
util living area													
	0.9723	0.9592	0.9266	0.8559	0.7365	0.5482	0.3954	0.4416	0.6897	0.8846	0.9552	0.9768	(86)
MIT	19.4349	19.6079	19.9254	20.3112	20.6355	20.8305	20.8885	20.8800	20.7452	20.3484	19.8467	19.4017	(87)
Th 2	19.8353	19.8415	19.8395	19.8434	19.8453	19.8507	19.8507	19.8524	19.8524	19.8490	19.8507	19.8434	(88)
util rest of house													
	0.9667	0.9509	0.9112	0.8247	0.6773	0.4540	0.2732	0.3159	0.6032	0.8519	0.9443	0.9720	(89)
MIT 2	17.7709	18.0243	18.4764	19.0155	19.4409	19.6630	19.7105	19.7078	19.5854	19.0843	18.3785	17.7288	(90)
Living area fraction									fLA = Living area / (4) =			0.1038	(91)
MIT	17.9436	18.1887	18.6268	19.1500	19.5649	19.7842	19.8328	19.8295	19.7058	19.2155	18.5309	17.9024	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.9436	18.1887	18.6268	19.1500	19.5649	19.7842	19.8328	19.8295	19.7058	19.2155	18.5309	17.9024	(93)

8. Space heating requirement

CALCULATION OF HEAT DEMAND 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9538	0.9349	0.8904	0.8021	0.6609	0.4481	0.2712	0.3133	0.5905	0.8291	0.9273	0.9606	(94)
Useful gains	1004.8932	1109.7009	1214.2575	1253.5130	1089.1883	771.5287	440.4921	473.1927	801.8583	968.3728	964.3542	941.9058	(95)
Ext temp.	5.0000	5.6000	7.3000	9.7000	12.7000	15.5000	17.5000	17.3000	14.9000	11.5000	8.0000	5.0000	(96)
Heat loss rate W													
	2521.4871	2437.5564	2197.5474	1826.2943	1324.2256	822.0142	447.5940	484.5152	920.5463	1482.9491	2020.5767	2493.5064	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	1128.3459	892.3189	731.5677	412.4025	174.8678	0.0000	0.0000	0.0000	0.0000	382.8447	760.4802	1154.3909	(98)
Space heating												5637.2185	(98)
RHI space heating demand												5637	(98)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	66.1800	(1b)	x 2.4700	(2b) =	163.4646	(1b) - (3b)
First floor	82.8600	(1c)	x 2.6400	(2c) =	218.7504	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	149.0400					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	382.2150	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1047	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3547	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3547	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4522	0.4433	0.4345	0.3901	0.3813	0.3369	0.3369	0.3281	0.3547	0.3813	0.3990	0.4167	(22b)
Effective ac	0.6022	0.5983	0.5944	0.5761	0.5727	0.5568	0.5568	0.5538	0.5629	0.5727	0.5796	0.5868	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Front Door			2.3300	1.4000	3.2620			(26)
Windows (Uw = 1.40)			25.3900	1.3258	33.6610			(27)
Garage Door			2.1000	1.4000	2.9400			(26)
Lantern Rooflight (Uw = 1.40)			1.8000	1.3258	2.3864			(27a)
Ground Floor			41.5900	0.1200	4.9908	75.0000	3119.2500	(28a)
Exposed Floor			24.5900	0.1500	3.6885	20.0000	491.8000	(28b)
External Wall	173.6800	27.3600	146.3200	0.1800	26.3376	60.0000	8779.2000	(29a)
Dormer Walls	9.2400	2.4600	6.7800	0.1700	1.1526	9.0000	61.0200	(29a)
Bay Roof	2.3100		2.3100	0.1500	0.3465	9.0000	20.7900	(30)
Flat Roof	5.5200	1.8000	3.7200	0.1400	0.5208	9.0000	33.4800	(30)
Pitched Cold Roof	58.2800		58.2800	0.1000	5.8280	9.0000	524.5200	(30)
Pitched Sloping Roof	18.4600		18.4600	0.1300	2.3998	9.0000	166.1400	(30)
Dormer Flat Roof	3.0700		3.0700	0.1300	0.3991	9.0000	27.6300	(30)
Over Garage Flat Roof	7.5100		7.5100	0.1400	1.0514	9.0000	67.5900	(30)
Total net area of external elements Aum(A, m2)			344.2500					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	88.9644			(33)
Party Wall			10.5600	0.0000	0.0000	70.0000	739.2000	(32)
Internal Wall Masonary			39.5900			75.0000	2969.2500	(32c)
Internal Wall Timber			145.5400			9.0000	1309.8600	(32c)
Internal Floor			58.2800			18.0000	1049.0400	(32d)
Internal Ceiling			58.2800			18.0000	1049.0400	(32e)
Heat capacity Cm = Sum(A x k)				(28)...(30) + (32) + (32a)...(32e) =	20407.8100			(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							136.9284	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							34.4421	(36)
Total fabric heat loss					(33) + (36) =		123.4065	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	75.9604	75.4597	74.9689	72.6636	72.2322	70.2244	70.2244	69.8526	70.9978	72.2322	73.1048	74.0170	(38)
Heat transfer coeff	199.3670	198.8662	198.3754	196.0701	195.6388	193.6309	193.6309	193.2591	194.4043	195.6388	196.5113	197.4236	(39)
Average = Sum(39)m / 12 =												196.0680	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3377	1.3343	1.3310	1.3156	1.3127	1.2992	1.2992	1.2967	1.3044	1.3127	1.3185	1.3246	(40)
HLP (average)												1.3155	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Assumed occupancy												2.9327	(42)
Average daily hot water use (litres/day)												103.8511	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	114.2363	110.0822	105.9282	101.7741	97.6201	93.4660	93.4660	97.6201	101.7741	105.9282	110.0822	114.2363	(44)
Energy conte	169.4091	148.1663	152.8943	133.2970	127.9016	110.3694	102.2734	117.3603	118.7619	138.4056	151.0805	164.0636	(45)
Energy content (annual)										Total = Sum(45)m =		1633.9829	(45)
Distribution loss (46)m = 0.15 x (45)m													
	25.4114	22.2249	22.9341	19.9945	19.1852	16.5554	15.3410	17.6040	17.8143	20.7608	22.6621	24.6095	(46)
Water storage loss:													
Store volume												210.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.9500	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												1.0530	(55)
Total storage loss													
	32.6430	29.4840	32.6430	31.5900	32.6430	31.5900	32.6430	32.6430	31.5900	32.6430	31.5900	32.6430	(56)
If cylinder contains dedicated solar storage													
	32.6430	29.4840	32.6430	31.5900	32.6430	31.5900	32.6430	32.6430	31.5900	32.6430	31.5900	32.6430	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month													
	225.3145	198.6615	208.7997	187.3990	183.8070	164.4714	158.1788	173.2657	172.8639	194.3110	205.1825	219.9690	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	225.3145	198.6615	208.7997	187.3990	183.8070	164.4714	158.1788	173.2657	172.8639	194.3110	205.1825	219.9690	(64)
									Total per year (kWh/year) = Sum(64)m =			2292.2239	(64)
Heat gains from water heating, kWh/month													
	101.0528	89.6614	95.5617	87.6028	87.2516	79.9794	78.7302	83.7466	82.7699	90.7442	93.5159	99.2755	(65)

5. Internal gains (see Table 5 and 5a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	175.9608	175.9608	175.9608	175.9608	175.9608	175.9608	175.9608	175.9608	175.9608	175.9608	175.9608	175.9608	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	72.4243	64.3266	52.3139	39.6050	29.6052	24.9940	27.0069	35.1045	47.1172	59.8261	69.8259	74.4372	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	476.8307	481.7787	469.3099	442.7652	409.2573	377.7647	356.7256	351.7776	364.2465	390.7911	424.2990	455.7916	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	55.5288	55.5288	55.5288	55.5288	55.5288	55.5288	55.5288	55.5288	55.5288	55.5288	55.5288	55.5288	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-117.3072	-117.3072	-117.3072	-117.3072	-117.3072	-117.3072	-117.3072	-117.3072	-117.3072	-117.3072	-117.3072	-117.3072	(71)
Water heating gains (Table 5)													
	135.8237	133.4248	128.4431	121.6706	117.2737	111.0825	105.8202	112.5626	114.9582	121.9680	129.8831	133.4348	(72)
Total internal gains													
	799.2610	793.7124	764.2492	718.2232	670.3186	628.0235	603.7351	613.6272	640.5043	686.7676	738.1904	777.8460	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	1.3400	11.2829	0.6300	0.7000	0.7700	4.6206	(75)
Southeast	9.9700	36.7938	0.6300	0.7000	0.7700	112.1094	(77)
Southwest	2.4700	36.7938	0.6300	0.7000	0.7700	27.7743	(79)
Northwest	11.6100	11.2829	0.6300	0.7000	0.7700	40.0338	(81)
North	1.8000	26.0000	0.6300	0.7000	1.0000	18.5749	(82)

Solar gains	203.1130	367.7477	558.3652	780.0614	951.1456	977.4876	928.6389	796.4731	634.7147	421.5762	247.3111	171.1812	(83)
Total gains	1002.3740	1161.4601	1322.6144	1498.2846	1621.4642	1605.5111	1532.3739	1410.1003	1275.2190	1108.3438	985.5015	949.0271	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	28.4342	28.5058	28.5763	28.9123	28.9760	29.2765	29.2765	29.3328	29.1600	28.9760	28.8474	28.7141	
alpha	2.8956	2.9004	2.9051	2.9275	2.9317	2.9518	2.9518	2.9555	2.9440	2.9317	2.9232	2.9143	
util living area													
	0.9782	0.9657	0.9406	0.8852	0.7869	0.6439	0.5076	0.5594	0.7650	0.9155	0.9669	0.9812	(86)
MIT	19.2665	19.4531	19.7653	20.1730	20.5261	20.7639	20.8565	20.8383	20.6508	20.1911	19.6593	19.2357	(87)
Th 2	19.8114	19.8141	19.8166	19.8287	19.8309	19.8415	19.8415	19.8434	19.8374	19.8309	19.8264	19.8216	(88)
util rest of house													
	0.9738	0.9588	0.9283	0.8602	0.7385	0.5604	0.3917	0.4434	0.6945	0.8918	0.9591	0.9775	(89)
MIT 2	17.5104	17.7817	18.2320	18.8153	19.2915	19.5889	19.6797	19.6685	19.4665	18.8546	18.0919	17.4727	(90)
Living area fraction									fLA = Living area / (4) =			0.1038	(91)
MIT	17.6927	17.9552	18.3912	18.9562	19.4197	19.7109	19.8019	19.7899	19.5894	18.9934	18.2546	17.6557	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.6927	17.9552	18.3912	18.9562	19.4197	19.7109	19.8019	19.7899	19.5894	18.9934	18.2546	17.6557	(93)

8. Space heating requirement

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Utilisation	0.9626	0.9440	0.9087	0.8371	0.7186	0.5499	0.3874	0.4375	0.6767	0.8695	0.9444	0.9674	(94)
Useful gains	964.8571	1096.3736	1201.8024	1254.2533	1165.1841	882.8397	593.7073	616.8944	862.9423	963.7194	930.7044	918.0983	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	2670.0607	2596.2377	2358.9125	1971.7197	1510.2652	989.6228	619.9810	655.1341	1067.1718	1642.0649	2192.0102	2656.4635	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	1268.6715	1007.9087	860.8899	516.5758	256.7404	0.0000	0.0000	0.0000	0.0000	504.6890	908.1402	1293.3437	(98)
Space heating												6616.9591	(98)
Space heating per m2											(98) / (4) =	44.3972	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.7000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												7295.4346	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	1268.6715	1007.9087	860.8899	516.5758	256.7404	0.0000	0.0000	0.0000	0.0000	504.6890	908.1402	1293.3437	(98)
Space heating efficiency (main heating system 1)	90.7000	90.7000	90.7000	90.7000	90.7000	0.0000	0.0000	0.0000	0.0000	90.7000	90.7000	90.7000	(210)
Space heating fuel (main heating system)	1398.7558	1111.2554	949.1620	569.5433	283.0654	0.0000	0.0000	0.0000	0.0000	556.4378	1001.2571	1425.9578	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	225.3145	198.6615	208.7997	187.3990	183.8070	164.4714	158.1788	173.2657	172.8639	194.3110	205.1825	219.9690	(64)
Efficiency of water heater												80.0000	(216)
(217)m	88.9066	88.7457	88.3923	87.5817	85.9061	80.0000	80.0000	80.0000	80.0000	87.4486	88.5180	88.9703	(217)
Fuel for water heating, kWh/month	253.4282	223.8549	236.2194	213.9704	213.9627	205.5892	197.7235	216.5821	216.0799	222.2001	231.7974	247.2387	(219)
Water heating fuel used												2678.6465	(219)
Annual totals kWh/year													
Space heating fuel - main system												7295.4346	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												511.6142	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 2.50 * 1029 * 1.00) =										-2058.3734		-2058.3734	(233)
Total delivered energy for all uses												8502.3218	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	7295.4346	3.4800	253.8811	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	2678.6465	3.4800	93.2169	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	511.6142	13.1900	67.4819	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-2058.3734	13.1900	-271.4995	(252)
Total energy cost			272.9730	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	0.5909	(257)
SAP value		91.7576	
SAP rating (Section 12)		92	(258)
SAP band		A	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	7295.4346	0.2160	1575.8139	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2678.6465	0.2160	578.5876	(264)
Space and water heating			2154.4015	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Energy for lighting	511.6142	0.5190	265.5278 (268)
Energy saving/generation technologies			
PV Unit	-2058.3734	0.5190	-1068.2958 (269)
Total kg/year			1390.5585 (272)
CO2 emissions per m2			9.3300 (273)
EI value			90.3971
EI rating			90 (274)
EI band			B

Calculation of stars for heating and DHW

Main heating energy efficiency	3.48 × (1 + 0.29 × 0.25) / 0.9070 = 4.115, stars = 4
Main heating environmental impact	0.216 × (1 + 0.29 × 0.25) / 0.9070 = 0.2554, stars = 4
Water heating energy efficiency	3.48 / 0.8537 = 4.076, stars = 4
Water heating environmental impact	0.216 / 0.8537 = 0.2530, stars = 4

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	66.1800	(1b)	x 2.4700	(2b) =	163.4646	(1b) - (3b)
First floor	82.8600	(1c)	x 2.6400	(2c) =	218.7504	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	149.0400					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	382.2150	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1047	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3547	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3547	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.1000	3.8000	3.9000	3.7000	3.6000	3.3000	3.3000	3.2000	3.2000	3.4000	3.3000	3.7000	(22)
Wind factor	1.0250	0.9500	0.9750	0.9250	0.9000	0.8250	0.8250	0.8000	0.8000	0.8500	0.8250	0.9250	(22a)
Adj infilt rate	0.3635	0.3369	0.3458	0.3281	0.3192	0.2926	0.2926	0.2837	0.2837	0.3015	0.2926	0.3281	(22b)
Effective ac	0.5661	0.5568	0.5598	0.5538	0.5509	0.5428	0.5428	0.5402	0.5402	0.5454	0.5428	0.5538	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Front Door			2.3300	1.4000	3.2620			(26)
Windows (Uw = 1.40)			25.3900	1.3258	33.6610			(27)
Garage Door			2.1000	1.4000	2.9400			(26)
Lantern Rooflight (Uw = 1.40)			1.8000	1.3258	2.3864			(27a)
Ground Floor			41.5900	0.1200	4.9908	75.0000	3119.2500	(28a)
Exposed Floor			24.5900	0.1500	3.6885	20.0000	491.8000	(28b)
External Wall	173.6800	27.3600	146.3200	0.1800	26.3376	60.0000	8779.2000	(29a)
Dormer Walls	9.2400	2.4600	6.7800	0.1700	1.1526	9.0000	61.0200	(29a)
Bay Roof	2.3100		2.3100	0.1500	0.3465	9.0000	20.7900	(30)
Flat Roof	5.5200	1.8000	3.7200	0.1400	0.5208	9.0000	33.4800	(30)
Pitched Cold Roof	58.2800		58.2800	0.1000	5.8280	9.0000	524.5200	(30)
Pitched Sloping Roof	18.4600		18.4600	0.1300	2.3998	9.0000	166.1400	(30)
Dormer Flat Roof	3.0700		3.0700	0.1300	0.3991	9.0000	27.6300	(30)
Over Garage Flat Roof	7.5100		7.5100	0.1400	1.0514	9.0000	67.5900	(30)
Total net area of external elements Aum(A, m2)			344.2500					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	88.9644			(33)
Party Wall			10.5600	0.0000	0.0000	70.0000	739.2000	(32)
Internal Wall Masonary			39.5900			75.0000	2969.2500	(32c)
Internal Wall Timber			145.5400			9.0000	1309.8600	(32c)
Internal Floor			58.2800			18.0000	1049.0400	(32d)
Internal Ceiling			58.2800			18.0000	1049.0400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	20407.8100 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		136.9284 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		34.4421 (36)
Total fabric heat loss	(33) + (36) =	123.4065 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	71.3994	70.2244	70.6061	69.8526	69.4906	68.4644	68.4644	68.1421	68.1421	68.7966	68.4644	69.8526	(38)
Heat transfer coeff	194.8059	193.6309	194.0127	193.2591	192.8972	191.8709	191.8709	191.5487	191.5487	192.2031	191.8709	193.2591	(39)
Average = Sum(39)m / 12 =												192.7315	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3071	1.2992	1.3017	1.2967	1.2943	1.2874	1.2874	1.2852	1.2852	1.2896	1.2874	1.2967	(40)
HLP (average)												1.2932	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Assumed occupancy												2.9327	(42)
Average daily hot water use (litres/day)												103.8511	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	114.2363	110.0822	105.9282	101.7741	97.6201	93.4660	93.4660	97.6201	101.7741	105.9282	110.0822	114.2363	(44)
Energy conte	169.4091	148.1663	152.8943	133.2970	127.9016	110.3694	102.2734	117.3603	118.7619	138.4056	151.0805	164.0636	(45)
Energy content (annual)										Total = Sum(45)m =		1633.9829	(45)
Distribution loss (46)m = 0.15 x (45)m													
	25.4114	22.2249	22.9341	19.9945	19.1852	16.5554	15.3410	17.6040	17.8143	20.7608	22.6621	24.6095	(46)
Water storage loss:													
Store volume												210.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.9500	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												1.0530	(55)
Total storage loss													
	32.6430	29.4840	32.6430	31.5900	32.6430	31.5900	32.6430	32.6430	31.5900	32.6430	31.5900	32.6430	(56)
If cylinder contains dedicated solar storage													
	32.6430	29.4840	32.6430	31.5900	32.6430	31.5900	32.6430	32.6430	31.5900	32.6430	31.5900	32.6430	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month													
	225.3145	198.6615	208.7997	187.3990	183.8070	164.4714	158.1788	173.2657	172.8639	194.3110	205.1825	219.9690	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	225.3145	198.6615	208.7997	187.3990	183.8070	164.4714	158.1788	173.2657	172.8639	194.3110	205.1825	219.9690	(64)
									Total per year (kWh/year) = Sum(64)m =			2292.2239	(64)
Heat gains from water heating, kWh/month													
	101.0528	89.6614	95.5617	87.6028	87.2516	79.9794	78.7302	83.7466	82.7699	90.7442	93.5159	99.2755	(65)

5. Internal gains (see Table 5 and 5a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	175.9608	175.9608	175.9608	175.9608	175.9608	175.9608	175.9608	175.9608	175.9608	175.9608	175.9608	175.9608	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	72.4243	64.3266	52.3139	39.6050	29.6052	24.9940	27.0069	35.1045	47.1172	59.8261	69.8259	74.4372	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	476.8307	481.7787	469.3099	442.7652	409.2573	377.7647	356.7256	351.7776	364.2465	390.7911	424.2990	455.7916	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	55.5288	55.5288	55.5288	55.5288	55.5288	55.5288	55.5288	55.5288	55.5288	55.5288	55.5288	55.5288	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-117.3072	-117.3072	-117.3072	-117.3072	-117.3072	-117.3072	-117.3072	-117.3072	-117.3072	-117.3072	-117.3072	-117.3072	(71)
Water heating gains (Table 5)													
	135.8237	133.4248	128.4431	121.6706	117.2737	111.0825	105.8202	112.5626	114.9582	121.9680	129.8831	133.4348	(72)
Total internal gains													
	799.2610	793.7124	764.2492	718.2232	670.3186	628.0235	603.7351	613.6272	640.5043	686.7676	738.1904	777.8460	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	1.3400	14.6223	0.6300	0.7000	0.7700	5.9882	(75)
Southeast	9.9700	45.2918	0.6300	0.7000	0.7700	138.0023	(77)
Southwest	2.4700	45.2918	0.6300	0.7000	0.7700	34.1891	(79)
Northwest	11.6100	14.6223	0.6300	0.7000	0.7700	51.8825	(81)
North	1.8000	34.0000	0.6300	0.7000	1.0000	24.2903	(82)

Solar gains	254.3523	393.2957	599.5238	844.4701	977.7732	1093.7885	1020.2135	896.9490	717.3407	481.2241	301.7977	202.7421	(83)
Total gains	1053.6133	1187.0081	1363.7731	1562.6933	1648.0918	1721.8120	1623.9485	1510.5762	1357.8450	1167.9917	1039.9881	980.5881	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	29.0999	29.2765	29.2189	29.3328	29.3879	29.5450	29.5450	29.5948	29.5948	29.4940	29.5450	29.3328	
alpha	2.9400	2.9518	2.9479	2.9555	2.9592	2.9697	2.9697	2.9730	2.9730	2.9663	2.9697	2.9555	
util living area													
	0.9723	0.9592	0.9266	0.8559	0.7365	0.5482	0.3954	0.4416	0.6897	0.8846	0.9552	0.9768	(86)
MIT	19.4349	19.6079	19.9254	20.3112	20.6355	20.8305	20.8885	20.8800	20.7452	20.3484	19.8467	19.4017	(87)
Th 2	19.8353	19.8415	19.8395	19.8434	19.8453	19.8507	19.8507	19.8524	19.8524	19.8490	19.8507	19.8434	(88)
util rest of house													
	0.9667	0.9509	0.9112	0.8247	0.6773	0.4540	0.2732	0.3159	0.6032	0.8519	0.9443	0.9720	(89)
MIT 2	17.7709	18.0243	18.4764	19.0155	19.4409	19.6630	19.7105	19.7078	19.5854	19.0843	18.3785	17.7288	(90)
Living area fraction									fLA = Living area / (4) =			0.1038	(91)
MIT	17.9436	18.1887	18.6268	19.1500	19.5649	19.7842	19.8328	19.8295	19.7058	19.2155	18.5309	17.9024	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.9436	18.1887	18.6268	19.1500	19.5649	19.7842	19.8328	19.8295	19.7058	19.2155	18.5309	17.9024	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Utilisation	0.9538	0.9349	0.8904	0.8021	0.6609	0.4481	0.2712	0.3133	0.5905	0.8291	0.9273	0.9606	(94)
Useful gains	1004.8932	1109.7009	1214.2575	1253.5130	1089.1883	771.5287	440.4921	473.1927	801.8583	968.3728	964.3542	941.9058	(95)
Ext temp.	5.0000	5.6000	7.3000	9.7000	12.7000	15.5000	17.5000	17.3000	14.9000	11.5000	8.0000	5.0000	(96)
Heat loss rate W	2521.4871	2437.5564	2197.5474	1826.2943	1324.2256	822.0142	447.5940	484.5152	920.5463	1482.9491	2020.5767	2493.5064	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	1128.3459	892.3189	731.5677	412.4025	174.8678	0.0000	0.0000	0.0000	0.0000	382.8447	760.4802	1154.3909	(98)
Space heating												5637.2185	(98)
Space heating per m2											(98) / (4) =	37.8235	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.7000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												6215.2354	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	1128.3459	892.3189	731.5677	412.4025	174.8678	0.0000	0.0000	0.0000	0.0000	382.8447	760.4802	1154.3909	(98)
Space heating efficiency (main heating system 1)	90.7000	90.7000	90.7000	90.7000	90.7000	0.0000	0.0000	0.0000	0.0000	90.7000	90.7000	90.7000	(210)
Space heating fuel (main heating system)	1244.0417	983.8135	806.5796	454.6885	192.7980	0.0000	0.0000	0.0000	0.0000	422.1001	838.4566	1272.7573	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	225.3145	198.6615	208.7997	187.3990	183.8070	164.4714	158.1788	173.2657	172.8639	194.3110	205.1825	219.9690	(64)
Efficiency of water heater												80.0000	(216)
(217)m	88.7248	88.5435	88.0841	87.0618	84.8820	80.0000	80.0000	80.0000	80.0000	86.7918	88.1936	88.7991	(217)
Fuel for water heating, kWh/month	253.9477	224.3659	237.0459	215.2481	216.5441	205.5892	197.7235	216.5821	216.0799	223.8817	232.6500	247.7154	(219)
Water heating fuel used												2687.3735	(219)
Annual totals kWh/year													
Space heating fuel - main system												6215.2354	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												511.6142	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 2.50 * 1139 * 1.00) =										-2278.1770		-2278.1770	(233)
Total delivered energy for all uses												7211.0461	(238)

10a. Fuel costs - using BEDF prices (512)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	6215.2354	9.7400	605.3639	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	2687.3735	9.7400	261.7502	(247)
Pumps and fans for heating	75.0000	36.8500	27.6375	(249)
Energy for lighting	511.6142	36.8500	188.5298	(250)
Additional standing charges			104.0000	(251)
Energy saving/generation technologies				
PV Unit	-2278.1770	36.8500	-839.5082	(252)
Total energy cost			347.7732	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	6215.2354	0.2160	1342.4908	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2687.3735	0.2160	580.4727	(264)
Space and water heating			1922.9635	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	511.6142	0.5190	265.5278	(268)
Energy saving/generation technologies				
PV Unit	-2278.1770	0.5190	-1182.3739	(269)
Total kg/year			1045.0424	(272)

13a. Primary energy - Individual heating systems including micro-CHP

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	6215.2354	1.2200	7582.5872	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2687.3735	1.2200	3278.5957	(264)
Space and water heating			10861.1829	(265)
Pumps and fans	75.0000	3.0700	230.2500	(267)
Energy for lighting	511.6142	3.0700	1570.6556	(268)
Energy saving/generation technologies				
PV Unit	-2278.1770	3.0700	-6994.0034	(269)
Primary energy kWh/year			5668.0851	(272)
Primary energy kWh/m2/year			38.0306	(273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: A 92
Current environmental impact rating: B 90

(For testing purposes):

A	Not considered
B	Not considered
C	Not considered
D	Not considered
E Low energy lighting	Already installed
F	Not considered
G	Not considered
H	Not considered
I	Not considered
J	Not considered
K	Not considered
M	Not considered
N Solar water heating	Recommended
O	Not considered
P	Not considered
R	Not considered
S	Not considered
T	Not considered
U Solar photovoltaic panels	Already installed
A2	Not considered
A3	Not considered
T2	Not considered
W	Not considered
X	Not considered
Y	Not considered
J2	Not considered
Q2	Not considered
Z1	Not considered
Z2	Not considered
Z3	Not considered
Z4	Not considered
Z5	Not considered
V2 Wind turbine	Not applicable
L2	Not considered
Q3	Not considered
O3	Not considered

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.2	-£ 116	-272 kg (26.0%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£116	1.82 kg/m²	A 93	A 92
Total Savings	£116	1.82 kg/m²		

Potential energy efficiency rating: A 93
Potential environmental impact rating: A 92

Fuel prices for cost data on this page from database revision number 512 TEST (15 Feb 2023)
Recommendation texts revision number 4.9c (22 Feb 2014)

Typical heating and lighting costs of this home (per year, Southern England):

	Current	Potential	Saving
Electricity	£216	£235	-£18
Mains gas	£971	£837	£134
Space heating	£737	£742	-£5
Water heating	£262	£141	£121
Lighting	£189	£189	£0
Generated (PV)	-£840	-£840	£0
Total cost of fuels	£347	£232	£116
Total cost of uses	£348	£232	£116
Delivered energy	48 kWh/m²	39 kWh/m²	9 kWh/m²
Carbon dioxide emissions	1.0 tonnes	0.8 tonnes	0.3 tonnes
CO2 emissions per m²	7 kg/m²	5 kg/m²	2 kg/m²
Primary energy	38 kWh/m²	28 kWh/m²	10 kWh/m²

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	66.1800	(1b)	x 2.4700	(2b) =	163.4646	(1b) - (3b)
First floor	82.8600	(1c)	x 2.6400	(2c) =	218.7504	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	149.0400					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	382.2150	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1047	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3547	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3547	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4522	0.4433	0.4345	0.3901	0.3813	0.3369	0.3369	0.3281	0.3547	0.3813	0.3990	0.4167	(22b)
Effective ac	0.6022	0.5983	0.5944	0.5761	0.5727	0.5568	0.5568	0.5538	0.5629	0.5727	0.5796	0.5868	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Front Door			2.3300	1.4000	3.2620			(26)
Windows (Uw = 1.40)			25.3900	1.3258	33.6610			(27)
Garage Door			2.1000	1.4000	2.9400			(26)
Lantern Rooflight (Uw = 1.40)			1.8000	1.3258	2.3864			(27a)
Ground Floor			41.5900	0.1200	4.9908	75.0000	3119.2500	(28a)
Exposed Floor			24.5900	0.1500	3.6885	20.0000	491.8000	(28b)
External Wall	173.6800	27.3600	146.3200	0.1800	26.3376	60.0000	8779.2000	(29a)
Dormer Walls	9.2400	2.4600	6.7800	0.1700	1.1526	9.0000	61.0200	(29a)
Bay Roof	2.3100		2.3100	0.1500	0.3465	9.0000	20.7900	(30)
Flat Roof	5.5200	1.8000	3.7200	0.1400	0.5208	9.0000	33.4800	(30)
Pitched Cold Roof	58.2800		58.2800	0.1000	5.8280	9.0000	524.5200	(30)
Pitched Sloping Roof	18.4600		18.4600	0.1300	2.3998	9.0000	166.1400	(30)
Dormer Flat Roof	3.0700		3.0700	0.1300	0.3991	9.0000	27.6300	(30)
Over Garage Flat Roof	7.5100		7.5100	0.1400	1.0514	9.0000	67.5900	(30)
Total net area of external elements Aum(A, m2)			344.2500					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	88.9644			(33)
Party Wall			10.5600	0.0000	0.0000	70.0000	739.2000	(32)
Internal Wall Masonary			39.5900			75.0000	2969.2500	(32c)
Internal Wall Timber			145.5400			9.0000	1309.8600	(32c)
Internal Floor			58.2800			18.0000	1049.0400	(32d)
Internal Ceiling			58.2800			18.0000	1049.0400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	20407.8100 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		136.9284 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		34.4421 (36)
Total fabric heat loss	(33) + (36) =	123.4065 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	75.9604	75.4597	74.9689	72.6636	72.2322	70.2244	70.2244	69.8526	70.9978	72.2322	73.1048	74.0170	(38)
Heat transfer coeff	199.3670	198.8662	198.3754	196.0701	195.6388	193.6309	193.6309	193.2591	194.4043	195.6388	196.5113	197.4236	(39)
Average = Sum(39)m / 12 =												196.0680	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3377	1.3343	1.3310	1.3156	1.3127	1.2992	1.2992	1.2967	1.3044	1.3127	1.3185	1.3246	(40)
HLP (average)												1.3155	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Assumed occupancy												2.9327	(42)
Average daily hot water use (litres/day)												103.8511	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	114.2363	110.0822	105.9282	101.7741	97.6201	93.4660	93.4660	97.6201	101.7741	105.9282	110.0822	114.2363	(44)
Energy conte	169.4091	148.1663	152.8943	133.2970	127.9016	110.3694	102.2734	117.3603	118.7619	138.4056	151.0805	164.0636	(45)
Energy content (annual)										Total = Sum(45)m =		1633.9829	(45)
Distribution loss (46)m = 0.15 x (45)m													
	25.4114	22.2249	22.9341	19.9945	19.1852	16.5554	15.3410	17.6040	17.8143	20.7608	22.6621	24.6095	(46)
Water storage loss:													
Store volume												210.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.9500	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												1.0530	(55)
Total storage loss													
	32.6430	29.4840	32.6430	31.5900	32.6430	31.5900	32.6430	32.6430	31.5900	32.6430	31.5900	32.6430	(56)
If cylinder contains dedicated solar storage													
	20.9848	18.9540	20.9848	20.3079	20.9848	20.3079	20.9848	20.9848	20.3079	20.9848	20.3079	20.9848	(57)
Primary loss	23.2624	21.0112	21.8667	15.7584	10.4681	9.9053	10.2355	11.1660	17.1091	21.8667	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month													
	213.6563	188.1315	195.7457	169.3632	159.3545	140.5825	133.4937	149.5110	156.1789	181.2570	193.9004	208.3108	(62)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1079.5246	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												1813.6014	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.1099	(H8)
Utilisation factor												0.5938	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												115.5000	(H13)
Daily hot water demand												103.8511	(H14)
Volume ratio Veff/V												1.1122	(H15)
Solar storage volume factor												1.0000	(H16)
Solar input												-946.9584	(H17)
Solar input	-27.4599	-45.8227	-78.0413	-104.5907	-129.2130	-127.0370	-125.3581	-109.5260	-85.7808	-58.5782	-32.5714	-22.9793	(63)
								Solar input (sum of months) = Sum(63)m =				-946.9584	(63)
Output from w/h													
	186.1963	142.3088	117.7045	64.7725	30.1415	13.5455	8.1356	39.9850	70.3981	122.6788	161.3290	185.3316	(64)
									Total per year (kWh/year) = Sum(64)m =			1142.5270	(64)
Heat gains from water heating, kWh/month													
	91.7263	81.2374	85.1185	73.1742	67.6896	60.8683	58.9821	64.7429	69.4219	80.3010	84.4902	89.9489	(65)

5. Internal gains (see Table 5 and 5a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	175.9608	175.9608	175.9608	175.9608	175.9608	175.9608	175.9608	175.9608	175.9608	175.9608	175.9608	175.9608	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	72.4243	64.3266	52.3139	39.6050	29.6052	24.9940	27.0069	35.1045	47.1172	59.8261	69.8259	74.4372	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	476.8307	481.7787	469.3099	442.7652	409.2573	377.7647	356.7256	351.7776	364.2465	390.7911	424.2990	455.7916	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	55.5288	55.5288	55.5288	55.5288	55.5288	55.5288	55.5288	55.5288	55.5288	55.5288	55.5288	55.5288	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-117.3072	-117.3072	-117.3072	-117.3072	-117.3072	-117.3072	-117.3072	-117.3072	-117.3072	-117.3072	-117.3072	-117.3072	(71)
Water heating gains (Table 5)													
	123.2880	120.8890	114.4066	101.6309	90.9806	84.5393	79.2770	87.0200	96.4193	107.9315	117.3474	120.8991	(72)
Total internal gains													
	786.7253	781.1767	750.2127	698.1835	644.0255	601.4803	577.1919	588.0845	621.9654	672.7311	725.6547	765.3102	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	1.3400	11.2829	0.6300	0.7000	0.7700	4.6206	(75)
Southeast	9.9700	36.7938	0.6300	0.7000	0.7700	112.1094	(77)
Southwest	2.4700	36.7938	0.6300	0.7000	0.7700	27.7743	(79)
Northwest	11.6100	11.2829	0.6300	0.7000	0.7700	40.0338	(81)
North	1.8000	26.0000	0.6300	0.7000	1.0000	18.5749	(82)

Solar gains	203.1130	367.7477	558.3652	780.0614	951.1456	977.4876	928.6389	796.4731	634.7147	421.5762	247.3111	171.1812	(83)
Total gains	989.8383	1148.9244	1308.5779	1478.2448	1595.1712	1578.9679	1505.8308	1384.5576	1256.6801	1094.3073	972.9658	936.4914	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	28.4342	28.5058	28.5763	28.9123	28.9760	29.2765	29.2765	29.3328	29.1600	28.9760	28.8474	28.7141	
alpha	2.8956	2.9004	2.9051	2.9275	2.9317	2.9518	2.9518	2.9555	2.9440	2.9317	2.9232	2.9143	
util living area													

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

	0.9789	0.9666	0.9420	0.8882	0.7924	0.6508	0.5147	0.5670	0.7703	0.9178	0.9679	0.9819	(86)
MIT	19.2584	19.4453	19.7573	20.1637	20.5177	20.7595	20.8546	20.8356	20.6455	20.1838	19.6515	19.2275	(87)
Th 2	19.8114	19.8141	19.8166	19.8287	19.8309	19.8415	19.8415	19.8434	19.8374	19.8309	19.8264	19.8216	(88)
util rest of house													
	0.9746	0.9599	0.9299	0.8637	0.7446	0.5673	0.3979	0.4503	0.7004	0.8946	0.9603	0.9782	(89)
MIT 2	17.4987	17.7706	18.2209	18.8029	19.2816	19.5849	19.6785	19.6667	19.4608	18.8448	18.0808	17.4608	(90)
Living area fraction									fLA = Living area / (4) =			0.1038	(91)
MIT	17.6814	17.9445	18.3803	18.9441	19.4099	19.7068	19.8006	19.7881	19.5838	18.9838	18.2438	17.6442	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.6814	17.9445	18.3803	18.9441	19.4099	19.7068	19.8006	19.7881	19.5838	18.9838	18.2438	17.6442	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9636	0.9452	0.9105	0.8407	0.7244	0.5565	0.3934	0.4442	0.6822	0.8724	0.9459	0.9684	(94)
Useful gains	953.8139	1085.9906	1191.4600	1242.7170	1155.6003	878.6571	592.3809	614.9794	857.3371	954.6730	920.3115	906.8813	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	2667.8070	2594.1029	2356.7695	1969.3508	1508.3579	988.8359	619.7334	654.7758	1066.0691	1640.2011	2189.8897	2654.1956	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	1275.2108	1013.4515	866.9902	523.1764	262.4516	0.0000	0.0000	0.0000	0.0000	510.0329	914.0963	1300.0018	(98)
Space heating												6665.4117	(98)
Space heating per m2											(98) / (4) =	44.7223	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.7000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												7348.8552	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	1275.2108	1013.4515	866.9902	523.1764	262.4516	0.0000	0.0000	0.0000	0.0000	510.0329	914.0963	1300.0018	(98)
Space heating efficiency (main heating system 1)													
	90.7000	90.7000	90.7000	90.7000	90.7000	0.0000	0.0000	0.0000	0.0000	90.7000	90.7000	90.7000	(210)
Space heating fuel (main heating system)													
	1405.9657	1117.3666	955.8878	576.8207	289.3623	0.0000	0.0000	0.0000	0.0000	562.3296	1007.8240	1433.2986	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	186.1963	142.3088	117.7045	64.7725	30.1415	13.5455	8.1356	39.9850	70.3981	122.6788	161.3290	185.3316	(64)
Efficiency of water heater												80.0000	(216)
(217)m	89.1803	89.2305	89.2727	89.3830	89.4673	80.0000	80.0000	80.0000	80.0000	88.4073	88.9160	89.2112	(217)
Fuel for water heating, kWh/month													
	208.7865	159.4845	131.8482	72.4663	33.6899	16.9319	10.1694	49.9812	87.9976	138.7654	181.4398	207.7448	(219)
Water heating fuel used												1299.3054	(219)
Annual totals kWh/year													
Space heating fuel - main system												7348.8552	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												511.6142	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 2.50 * 1029 * 1.00) =										-2058.3734		-2058.3734	(233)
Total delivered energy for all uses												7226.4014	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	7348.8552	3.4800	255.7402	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1299.3054	3.4800	45.2158	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	511.6142	13.1900	67.4819	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-2058.3734	13.1900	-271.4995	(252)
Total energy cost			233.4259	(255)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	0.5053	(257)
SAP value		92.9517	
SAP rating (Section 12)		93	(258)
SAP band		A	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	7348.8552	0.2160	1587.3527	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1299.3054	0.2160	280.6500	(264)
Space and water heating			1868.0027	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	511.6142	0.5190	265.5278	(268)
Energy saving/generation technologies				
PV Unit	-2058.3734	0.5190	-1068.2958	(269)
Total kg/year			1130.1097	(272)
CO2 emissions per m2			7.5800	(273)
EI value			92.1957	
EI rating			92	(274)
EI band			A	

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	66.1800	(1b)	x 2.4700	(2b) =	163.4646	(1b) - (3b)
First floor	82.8600	(1c)	x 2.6400	(2c) =	218.7504	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	149.0400					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	382.2150	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1047	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3547	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3547	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.1000	3.8000	3.9000	3.7000	3.6000	3.3000	3.3000	3.2000	3.2000	3.4000	3.3000	3.7000	(22)
Wind factor	1.0250	0.9500	0.9750	0.9250	0.9000	0.8250	0.8250	0.8000	0.8000	0.8500	0.8250	0.9250	(22a)
Adj infilt rate	0.3635	0.3369	0.3458	0.3281	0.3192	0.2926	0.2926	0.2837	0.2837	0.3015	0.2926	0.3281	(22b)
Effective ac	0.5661	0.5568	0.5598	0.5538	0.5509	0.5428	0.5428	0.5402	0.5402	0.5454	0.5428	0.5538	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Front Door			2.3300	1.4000	3.2620			(26)
Windows (Uw = 1.40)			25.3900	1.3258	33.6610			(27)
Garage Door			2.1000	1.4000	2.9400			(26)
Lantern Rooflight (Uw = 1.40)			1.8000	1.3258	2.3864			(27a)
Ground Floor			41.5900	0.1200	4.9908	75.0000	3119.2500	(28a)
Exposed Floor			24.5900	0.1500	3.6885	20.0000	491.8000	(28b)
External Wall	173.6800	27.3600	146.3200	0.1800	26.3376	60.0000	8779.2000	(29a)
Dormer Walls	9.2400	2.4600	6.7800	0.1700	1.1526	9.0000	61.0200	(29a)
Bay Roof	2.3100		2.3100	0.1500	0.3465	9.0000	20.7900	(30)
Flat Roof	5.5200	1.8000	3.7200	0.1400	0.5208	9.0000	33.4800	(30)
Pitched Cold Roof	58.2800		58.2800	0.1000	5.8280	9.0000	524.5200	(30)
Pitched Sloping Roof	18.4600		18.4600	0.1300	2.3998	9.0000	166.1400	(30)
Dormer Flat Roof	3.0700		3.0700	0.1300	0.3991	9.0000	27.6300	(30)
Over Garage Flat Roof	7.5100		7.5100	0.1400	1.0514	9.0000	67.5900	(30)
Total net area of external elements Aum(A, m2)			344.2500					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	88.9644			(33)
Party Wall			10.5600	0.0000	0.0000	70.0000	739.2000	(32)
Internal Wall Masonary			39.5900			75.0000	2969.2500	(32c)
Internal Wall Timber			145.5400			9.0000	1309.8600	(32c)
Internal Floor			58.2800			18.0000	1049.0400	(32d)
Internal Ceiling			58.2800			18.0000	1049.0400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	20407.8100 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		136.9284 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		34.4421 (36)
Total fabric heat loss	(33) + (36) =	123.4065 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	71.3994	70.2244	70.6061	69.8526	69.4906	68.4644	68.4644	68.1421	68.1421	68.7966	68.4644	69.8526	(38)
Heat transfer coeff	194.8059	193.6309	194.0127	193.2591	192.8972	191.8709	191.8709	191.5487	191.5487	192.2031	191.8709	193.2591	(39)
Average = Sum(39)m / 12 =												192.7315	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3071	1.2992	1.3017	1.2967	1.2943	1.2874	1.2874	1.2852	1.2852	1.2896	1.2874	1.2967	(40)
HLP (average)												1.2932	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

Assumed occupancy												2.9327	(42)
Average daily hot water use (litres/day)												103.8511	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	114.2363	110.0822	105.9282	101.7741	97.6201	93.4660	93.4660	97.6201	101.7741	105.9282	110.0822	114.2363	(44)
Energy conte	169.4091	148.1663	152.8943	133.2970	127.9016	110.3694	102.2734	117.3603	118.7619	138.4056	151.0805	164.0636	(45)
Energy content (annual)										Total = Sum(45)m =		1633.9829	(45)
Distribution loss (46)m = 0.15 x (45)m													
	25.4114	22.2249	22.9341	19.9945	19.1852	16.5554	15.3410	17.6040	17.8143	20.7608	22.6621	24.6095	(46)
Water storage loss:													
Store volume												210.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.9500	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												1.0530	(55)
Total storage loss													
	32.6430	29.4840	32.6430	31.5900	32.6430	31.5900	32.6430	32.6430	31.5900	32.6430	31.5900	32.6430	(56)
If cylinder contains dedicated solar storage													
	20.9848	18.9540	20.9848	20.3079	20.9848	20.3079	20.9848	20.9848	20.3079	20.9848	20.3079	20.9848	(57)
Primary loss	23.2624	21.0112	21.8667	15.7584	10.4681	9.9053	10.2355	11.1660	17.1091	21.8667	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month													
	213.6563	188.1315	195.7457	169.3632	159.3545	140.5825	133.4937	149.5110	156.1789	181.2570	193.9004	208.3108	(62)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1190.5240	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												2000.0804	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.2241	(H8)
Utilisation factor												0.5582	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												115.5000	(H13)
Daily hot water demand												103.8511	(H14)
Volume ratio Veff/V												1.1122	(H15)
Solar storage volume factor												1.0000	(H16)
Solar input												-981.7298	(H17)
Solar input	-32.5495	-46.2776	-78.7770	-105.9727	-124.0793	-132.7502	-128.6201	-115.3187	-90.9638	-63.0453	-37.6010	-25.7745	(63)
									Solar input (sum of months) = Sum(63)m =			-981.7298	(63)
Output from w/h													
	181.1068	141.8539	116.9687	63.3905	35.2752	7.8323	4.8735	34.1923	65.2151	118.2117	156.2993	182.5363	(64)
									Total per year (kWh/year) = Sum(64)m =			1107.7557	(64)
Heat gains from water heating, kWh/month													
	91.7263	81.2374	85.1185	73.1742	67.6896	60.8683	58.9821	64.7429	69.4219	80.3010	84.4902	89.9489	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	175.9608	175.9608	175.9608	175.9608	175.9608	175.9608	175.9608	175.9608	175.9608	175.9608	175.9608	175.9608	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	72.4243	64.3266	52.3139	39.6050	29.6052	24.9940	27.0069	35.1045	47.1172	59.8261	69.8259	74.4372	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	476.8307	481.7787	469.3099	442.7652	409.2573	377.7647	356.7256	351.7776	364.2465	390.7911	424.2990	455.7916	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	55.5288	55.5288	55.5288	55.5288	55.5288	55.5288	55.5288	55.5288	55.5288	55.5288	55.5288	55.5288	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-117.3072	-117.3072	-117.3072	-117.3072	-117.3072	-117.3072	-117.3072	-117.3072	-117.3072	-117.3072	-117.3072	-117.3072	(71)
Water heating gains (Table 5)													
	123.2880	120.8890	114.4066	101.6309	90.9806	84.5393	79.2770	87.0200	96.4193	107.9315	117.3474	120.8991	(72)
Total internal gains													
	786.7253	781.1767	750.2127	698.1835	644.0255	601.4803	577.1919	588.0845	621.9654	672.7311	725.6547	765.3102	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	1.3400	14.6223	0.6300	0.7000	0.7700	5.9882	(75)
Southeast	9.9700	45.2918	0.6300	0.7000	0.7700	138.0023	(77)
Southwest	2.4700	45.2918	0.6300	0.7000	0.7700	34.1891	(79)
Northwest	11.6100	14.6223	0.6300	0.7000	0.7700	51.8825	(81)
North	1.8000	34.0000	0.6300	0.7000	1.0000	24.2903	(82)

Solar gains	254.3523	393.2957	599.5238	844.4701	977.7732	1093.7885	1020.2135	896.9490	717.3407	481.2241	301.7977	202.7421	(83)
Total gains	1041.0776	1174.4724	1349.7366	1542.6536	1621.7987	1695.2688	1597.4053	1485.0335	1339.3061	1153.9551	1027.4524	968.0524	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	29.0999	29.2765	29.2189	29.3328	29.3879	29.5450	29.5450	29.5948	29.5948	29.4940	29.5450	29.3328	
alpha	2.9400	2.9518	2.9479	2.9555	2.9592	2.9697	2.9697	2.9730	2.9730	2.9663	2.9697	2.9555	
util living area													

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

	0.9731	0.9603	0.9283	0.8593	0.7426	0.5547	0.4012	0.4480	0.6952	0.8874	0.9565	0.9776	(86)
MIT	19.4269	19.6003	19.9178	20.3029	20.6287	20.8280	20.8877	20.8788	20.7414	20.3419	19.8392	19.3935	(87)
Th 2	19.8353	19.8415	19.8395	19.8434	19.8453	19.8507	19.8507	19.8524	19.8524	19.8490	19.8507	19.8434	(88)
util rest of house	0.9676	0.9521	0.9131	0.8286	0.6838	0.4600	0.2776	0.3210	0.6090	0.8552	0.9459	0.9729	(89)
MIT 2	17.7594	18.0134	18.4659	19.0047	19.4335	19.6610	19.7102	19.7073	19.5819	19.0759	18.3679	17.7170	(90)
Living area fraction									fLA = Living area / (4) =			0.1038	(91)
MIT	17.9325	18.1782	18.6166	19.1394	19.5575	19.7822	19.8324	19.8289	19.7022	19.2073	18.5206	17.8911	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.9325	18.1782	18.6166	19.1394	19.5575	19.7822	19.8324	19.8289	19.7022	19.2073	18.5206	17.8911	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9550	0.9363	0.8924	0.8060	0.6671	0.4539	0.2755	0.3182	0.5960	0.8324	0.9291	0.9617	(94)
Useful gains	994.1815	1099.6472	1204.5627	1243.4014	1081.8246	769.4063	440.1106	472.5860	798.2312	960.5629	954.5568	930.9530	(95)
Ext temp.	5.0000	5.6000	7.3000	9.7000	12.7000	15.5000	17.5000	17.3000	14.9000	11.5000	8.0000	5.0000	(96)
Heat loss rate W	2519.3236	2435.5189	2195.5652	1824.2529	1322.8018	821.6252	447.5202	484.3998	919.8580	1481.3658	2018.5980	2491.3134	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	1134.7058	897.7058	737.3059	418.2131	179.2870	0.0000	0.0000	0.0000	0.0000	387.4774	766.1097	1160.9082	(98)
Space heating												5681.7128	(98)
Space heating per m2											(98) / (4) =	38.1221	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.7000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	6264.2920	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	1134.7058	897.7058	737.3059	418.2131	179.2870	0.0000	0.0000	0.0000	0.0000	387.4774	766.1097	1160.9082	(98)
Space heating efficiency (main heating system 1)	90.7000	90.7000	90.7000	90.7000	90.7000	0.0000	0.0000	0.0000	0.0000	90.7000	90.7000	90.7000	(210)
Space heating fuel (main heating system)	1251.0538	989.7528	812.9062	461.0949	197.6704	0.0000	0.0000	0.0000	0.0000	427.2077	844.6634	1279.9429	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	181.1068	141.8539	116.9687	63.3905	35.2752	7.8323	4.8735	34.1923	65.2151	118.2117	156.2993	182.5363	(64)
Efficiency of water heater												80.0000	(216)
(217)m	89.0605	89.0743	89.0689	89.1309	88.7485	80.0000	80.0000	80.0000	80.0000	87.9502	88.6900	89.0811	(217)
Fuel for water heating, kWh/month	203.3526	159.2534	131.3239	71.1207	39.7474	9.7903	6.0919	42.7403	81.5189	134.4076	176.2311	204.9102	(219)
Water heating fuel used												1260.4885	(219)
Annual totals kWh/year													
Space heating fuel - main system												6264.2920	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												511.6142	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 2.50 * 1139 * 1.00) =										-2278.1770		-2278.1770	(233)
Total delivered energy for all uses												5883.2176	(238)

10a. Fuel costs - using BEDF prices (512)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	6264.2920	9.7400	610.1420	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1260.4885	9.7400	122.7716	(247)
Pumps and fans for heating	75.0000	36.8500	27.6375	(249)
Pump for solar water heating	50.0000	36.8500	18.4250	(249)
Energy for lighting	511.6142	36.8500	188.5298	(250)
Additional standing charges			104.0000	(251)
Energy saving/generation technologies				
PV Unit	-2278.1770	36.8500	-839.5082	(252)
Total energy cost			231.9977	(255)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	6264.2920	0.2160	1353.0871	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1260.4885	0.2160	272.2655	(264)
Space and water heating			1625.3526	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	511.6142	0.5190	265.5278	(268)
Energy saving/generation technologies				
PV Unit	-2278.1770	0.5190	-1182.3739	(269)
Total kg/year			773.3815	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	6264.2920	1.2200	7642.4362	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1260.4885	1.2200	1537.7959	(264)
Space and water heating			9180.2321	(265)
Pumps and fans	125.0000	3.0700	383.7500	(267)
Energy for lighting	511.6142	3.0700	1570.6556	(268)
Energy saving/generation technologies				
PV Unit	-2278.1770	3.0700	-6994.0034	(269)
Primary energy kWh/year			4140.6343	(272)
Primary energy kWh/m2/year			27.7820	(273)

SAP 2012 OVERHEATING ASSESSMENT FOR New Build (As Designed) 9.92

Overheating Calculation Input Data

Dwelling type	SemiDetached House
Number of storeys	2
Cross ventilation possible	Yes
SAP Region	Southern England
Front of dwelling faces	North West
Overshading	Average or unknown
Thermal mass parameter	136.9 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	8.00 (Windows fully open)

Overheating Calculation

Summer ventilation heat loss coefficient	1009.05	(P1)
Transmission heat loss coefficient	123.41	(37)
Summer heat loss coefficient	1132.45	(P2)

Overhangs

Orientation	Ratio	Z_overhangs	Overhang type
North East	0.000	1.000	None
South East	0.000	1.000	None
South West	0.000	1.000	None
North West	0.000	1.000	None

Solar shading

Orientation	Z blinds	Solar access	Z overhangs	Z summer	
North	1.000	1.00	1.000	1.000	(P8)
North East	1.000	0.90	1.000	0.900	(P8)
South East	1.000	0.90	1.000	0.900	(P8)
South West	1.000	0.90	1.000	0.900	(P8)
North West	1.000	0.90	1.000	0.900	(P8)

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
North East	1.3400	106.0502	0.6300	0.7000	0.9000	50.7621
South East	9.9700	127.3119	0.6300	0.7000	0.9000	453.4064
South West	2.4700	127.3119	0.6300	0.7000	0.9000	112.3284
North West	11.6100	106.0502	0.6300	0.7000	0.9000	439.8123
North	1.8000	217.0000	0.6300	0.7000	1.0000	155.0291
total:						1211.3383

	Jun	Jul	Aug	
Solar gains	1306	1211	1060	(P3)
Internal gains	628	604	614	
Total summer gains	1934	1815	1674	(P5)
Summer gain/loss ratio	1.71	1.60	1.48	(P6)
Summer external temperature	15.40	17.30	17.30	

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

Thermal mass temperature increment (TMP = 136.9)	1.04	1.04	1.04	
Threshold temperature	18.15	19.94	19.82	(P7)
Likelihood of high internal temperature	Not significant	Not significant	Not significant	

Assessment of likelihood of high internal temperature: Not significant

PREDICTED ENERGY ASSESSMENT

Design SAP
elmhurst energy

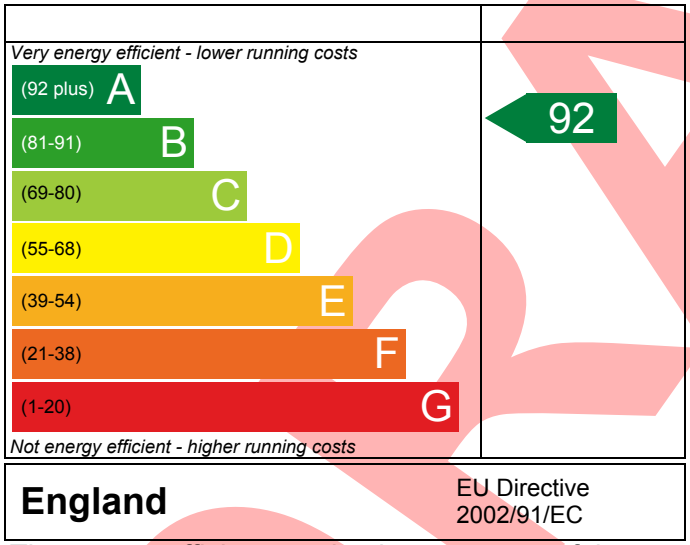
Tree House, Larg Drive,
Winchester,
Hampshire,
SO22 6NU

Dwelling type:	House, Semi-Detached
Date of assessment:	01/03/2023
Produced by:	Scott Spearing
Total floor area:	149.04 m²

This document is a Predicted Energy Assessment for properties marketed when they are incomplete. It includes a predicted energy rating which might not represent the final energy rating of the property on completion. Once the property is completed, this rating will be updated and an official Energy Performance Certificate will be created for the property. This will include more detailed information about the energy performance of the completed property.

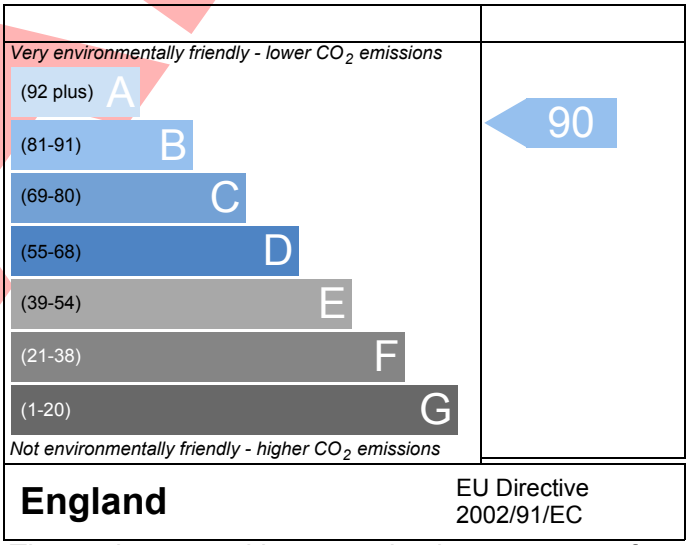
The energy performance has been assessed using the Government approved SAP2012 methodology and is rated in terms of the energy use per square meter of floor area; the energy efficiency is based on fuel costs and the environmental impact is based on carbon dioxide (CO_2) emissions.

Energy Efficiency Rating



The energy efficiency rating is a measure of the overall efficiency of a home. The higher the rating the more energy efficient the home is and the lower the fuel bills are likely to be.

Environmental Impact (CO_2) Rating



The environmental impact rating is a measure of a home's impact on the environment in terms of carbon dioxide (CO_2) emissions. The higher the rating the less impact it has on the environment.

DRAFT

This report has not been submitted through the Elmhurst Energy members' portal, therefore results are subject to change when the dwelling is completed.